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UNIVERSITY OF ALBERTA

EFFECTS OF MENTAL TRAINING ON THE PERFORMANCE OF MILITARY ENDURANCE AND PRECISION TASKS IN THE CANADIAN FORCES

by

Roger T. Couture

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES
AND RESEARCH IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY

DEPARTMENT OF PHYSICAL EDUCATION AND SPORT STUDIES

EDMONTON, ALBERTA

(SPRING, 1991)

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FACULTY OF GRADUATE STUDIES AND RESEARCH

The undersigned certify that they have read,
and recommend to the Faculty of Graduate Studies
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entitled: **The Effects of Mental Training**
on The Performance of Military Endurance and Precision Tasks
in the Canadian Forces submitted
by **Roger T. Couture** in
partial fulfillment
of the requirements for the degree of
Doctor of Philosophy.

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External Examiner Terry Orlick

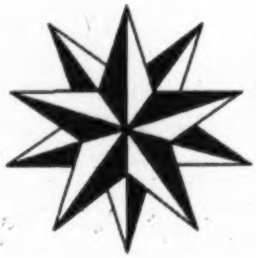
Date: March 4, 1991

DEDICATION

To my parents and sister,
whose love and encouragement
enabled me to explore
far beyond the realms of
a little mining town
in Northern Ontario.

"On mène à la ville une existence artificielle. La plupart des gens ne sentent jamais la terre sous leurs pieds, ne voient pas pousser les plantes autrement qu'en pots, et leurs regards ne se portent pas au-delà des lumières de la ville, pour saisir le charme d'un ciel de nuit parsemé d'étoiles . . ."

(Tatange Nani on Walking Buffalo, Londres, 1958)



ABSTRACT

The present study investigated the effects of two cognitive training strategies, associative and dissociative thinking on soldiers' ability to perform during a sixteen kilometer weight-loaded march and in a shooting test. In the study, a 4 (group) X 2 (trial) factorial design was used. In Trial one, 40 Infantry soldiers from the Canadian Army completed three hours of marching in a gymnasium and twenty five rounds of shooting in an indoor shooting range. Following the tasks, subjects were randomly assigned to one of four groups: an associative (biofeedback) group, a dissociative (meditation) group, a combined associative-dissociative (biofeedback and meditation) group and a control group.

After two weeks of mental training, the soldiers performed both the tasks, marching and shooting, again in Trial 2. A two-way repeated measures analysis of variance indicated a significant improvement ($p < .01$) in shooting accuracy by the combined group only. As well, results revealed a significant time (trial) main effect in improved ability to estimate the amount of time remaining in the march and ability to reduce heart rate levels while marching and shooting for subjects in all groups. Though soldiers in the experimental group found mental training to be very interesting and important, their results did not significantly differ from Trial 1 to Trial 2 in perceived fatigue levels and perceived rate of exertion during the march. However, the control group did significantly differ in perceived fatigue and in heart rate during shooting. Results are discussed in light of these findings.

PREFACE

In January of 1989, a team of four researchers decided to take on the challenge of developing a Mininum Physical Fitness Standard specific to the Canadian Infantry. It would increase the fitness requirement from the previous Minimum Physical Fitness Standards (MPFS) and Exercise Prescription Test (Ex-pres) set for the Military in general. After several months of consulting, the research team decided to approach the idea of optimizing the army's physical fitness level in a more holistic manner. It was felt that, in this project, there was a need to incorporate a psychological component.

In May of 1989, a fifth researcher was added to the team with the mandate of examining the impact of mental training on some common infantry tasks. As an adjunct to the large project, 44 soldiers were selected from the main project's random sample of 120 subjects. Although the main project dealt with laboratory (i.e., treadmill march, power lifting, arm ergometer, etc.) and field exercises (i.e., casualty evacuation, maximal and sub-maximal digging, maximal and sub-maximal jerry-can shuttle, maximal ammunition box lift, and weight-loaded march), this study examined two field tasks; the prolonged weight-loaded march and shooting accuracy.

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Sincere thanks go to those who served on the dissertation committee and made the candidacy and final defence an enriching and positive experience, Dr. Rick Alderman, Dr. George Fitzsimmons, Dr. Harvey Scott, Dr. Darius Young (access to your personal library was greatly appreciated) to Dr. Terry Orlick who served as the external examiner and to Dr. Brian Nielsen who served as the chairperson.

Special thanks go to Dr. Mohan Singh, Wayne Lee and Paul Chahal for inviting me to be part of the military research team. The experience provided me with a unique and very enriching view of the Canadian Military Forces, particularly with the Princess Patricia Canadian Light Infantry unit (1PPCLI).

A note of thanks goes to all my friends in Edmonton, especially Debra Covey and Valerie Kennedy for enriching my life with a wealth of moral support, encouragement and care. Thanks also go out to a dear friend, Muriel Clarke, for proof-reading my dissertation.

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INTRODUCTION

Need for the study

It has been said that war victories are more contingent on the quality of soldiers than on the calibre of their weapons (Rimland & Larson, 1986). Accordingly, military success relies significantly on the soldier; the "backbone" within the ranking hierarchy of authority.

In the way of training, a good soldier is someone who is physically fit, able to carry out physically strenuous orders, read mercator grid maps, do drills and handle weapons competently (Smith, 1972). With respect to handling weapons, not only are soldiers expected to master the technical skills of shooting, they are also expected to be mentally alert in preparation for highly stressful situations where their physical and mental integrity may be menaced. Although a soldier may be a technically perfect shooter, if the individual can't shoot accurately in times of distress, because of exhaustion and pain from the marching approach, the soldier and weapon lose their potential effectiveness. Light Infantry divisions are normally provided with little, in the way of transportation. Most often, infantry soldiers must depend on personal mobility to transport their equipment to the combat field (Knapik, 1989). It is therefore crucial that soldiers be able to avoid succumbing to pain and fatigue when going on long weight-loaded marches and be able to self-regulate their psychological stress levels especially when surrounded by a variety of uncontrollable stressors.

A developing body of research supports the notion that some long distance runners can mentally separate themselves from the inherent pain and fatigue resulting from marathon running. Morgan and Pollock (1977) suggest that two cognitive strategies are frequently used by runners; "association" and "dissociation". They theorize that dissociation is more pleasurable as it enables individuals to reduce "anxiety, effort sense and general discomfort" (Morgan, 1978, p. 46). It is also thought that dissociative strategies allow the marathon runners to persevere through temporary zones of boredom (Schomer, 1986). However, Morgan and Pollock (1977) found that world-class marathoners tend to apply predominantly associative techniques during marathon races to maintain an awareness of their pain and discomfort (Morgan, 1978). Morgan and Pollock (1977) describe runners' associative strategies as: scanning their body to identify painful or tense areas and thus remembering to lessen muscle tension while implementing feelings of relaxation; and thinking of their pace and race strategy (Morgan, 1978).

In light of Morgan and Pollock's findings, a number of other investigators have examined the effects of both cognitive strategies for improving endurance tolerance and general performance (Gill & Strom, 1985; Masters & Lambert, 1989; Schomer, 1986, 1987).

Although marathon running has been the focus of much research, other sorts of runs and endurance tasks have also been studied. For instance, performances of such tasks as treadmill endurance running and stationary cycling were found to improve with dissociative strategies such as listening to distracting noise or staring at a collage (Pennebaker and Lightner, 1980; Padgett and Hill, 1989; Gill and Strom, 1985; Rejeski and Kenney, 1987).

The majority of dissociative strategies utilized in the former studies pertained to external types of attentional focus. Such practices (i.e., staring at a picture, answering surveys) may not be readily available or feasible for army personnel performing drills or going into battle. To that effect, a dissociative internal type of attentional focus appears more appropriate. Moreover, the use of a distractive strategy during sustained performance would be considerably more beneficial if the technique was appropriate for other relevant military demands as well (e.g., shell scrape digging, casualty evacuations and shooting).

Several techniques support this line of thought. Weinberg, Smith, Jackson and Gould (1984) found a significant increase in persistence in holding one leg 40 cm off the floor with dissociation (imagery) and positive self-talk. "Pleasant imagery" dissociation and positive self-talk are also useful for pain tolerance and for nurturing a healthy attitude (Horan, 1973; Spanos, Horton and Chaves, 1975; Charlesworth and Nathan, 1984).

Morgan, Horstman, Cymerman and Stokes (1983) tested the effectiveness of dissociation implemented by Benson, Kotch, & Crassweller (1977) Relaxation Response (meditation) for treadmill running. A 32% increase in endurance time was noted for the dissociative group. Distraction through repeating a mantra, might benefit soldiers in a variety of environments away from controlled laboratory areas. For instance, if meditation is effective at increasing a person's ability to last longer during sustained performance, then soldiers will be capable of enduring longer approaches by foot. Meditative techniques have also been effective in positively altering arousals levels (Kabat-Zinn, Lipworth and Burney, 1985; Delmonte, 1984a; Girdano & Everly, 1986). Since meditative techniques have several beneficial properties, infantry soldiers would profit in several ways from learning and mastering this technique.

In the area of shooting, relaxation and self-regulation are of prime importance. Psychologically, a number of factors may come into play (e.g., distractions, mood, anxiety, etc.). For instance, in examining shooting accuracy, Doyle, Landers and Feltz (1980) gave 184 elite and sub-elite rifle athletes the State-Trait Anxiety Inventory (STAI) and a descriptive questionnaire. In brief, they noted three key differences between the more experienced and the less experienced shooters. The most experienced shooters were less trait-anxious than others. They showed more self-confidence and were less bothered by mistakes they made in competition than were other shooters. Thirdly, they used more imagery. The elite shooters pinpointed the two worst determinants to accurate shooting as being "inadequate preparation" and "nervous tension". The latter determinant motivated researchers to investigate the feasibility of using biofeedback. With a better understanding of certain self-regulatory mechanisms (heart rate, breathing patterns, muscular tension), improvement in shooting accuracy can be accelerated (Daniels, Landers and Wilkinson, 1980).

Biofeedback has been invoked in a number of studies to assist in self-regulating unsettled physiological components (e.g., racing heart rate, nervous tension, improper breathing pattern) that previously went unnoticed (Basmajian, 1989). With the added somatic feedback, an individual can concentrate effectively on the ideal physiological template. Several studies have investigated the significance of self-regulatory mechanisms to marksmanship.

Research has shown that elite shooters experienced better performances when shots occurred late in the cardiac cycle ($p<.03$) as opposed to on the R-spike of the QRS complex (Bird, 1987; Daniels et al., 1980; Daniels & Landers, 1981). Also, it has been found that elite shooters' resting heart rates should increase by no more than 13% to 30% to achieve an optimal pre-competitive shooting state (Bird, 1987; Daniels et al., 1980).

In essence, the infantry soldier must be ready to face combat in stressful environments. The psychological pressures may become overwhelming if individuals are unable to self-regulate their arousal and tension level. Mental training may assist in this self-regulation. Among the many mental training techniques, biofeedback is one of select few that can provide individuals with immediate feedback on their mental training abilities. Not only can biofeedback provide information on the immediate action or lack of it, but it is also useful for training individuals to alter physiological properties (i.e., heart rate, muscle tension, temperature). Unlike biofeedback, meditation enables persons to focus their attention away from the task at hand when appropriate (e.g., when performing non-threatening endurance tasks). Unlike biofeedback, meditation does not provide accurate and immediate feedback on arousal levels.

The following study will examine the effectiveness of two treatments either separately or combined for enhancing performance of an endurance march and shooting accuracy.

Justification of the Study

The study is justified on both practical and theoretical bases. From a practical perspective, the military spends a substantial amount of money on weapons yet quite often the weapons fail to function to their expectations or even fail to reach the combat zone because of human factors like fatigue and pain (Rimland & Larson, 1986). Some of the common types of debilitating pains during weight-loaded marches include blisters, tendonitis and stress fractures (Knapik, 1989). A considerable body of research suggests that individuals can perform sustained tasks effectively by using dissociative strategies (Morgan, Horstman, Cymerman and Stokes, 1983). As well, Spanos, Horton, and Chaves (1975), suggest that dissociative strategies can temporarily keep a person's mind off pain and fatigue. The temporary avoidance of pain may allow a soldier to reach the designated site and be able to shoot. Little or no research has examined the effects of cognitive strategies on weight-loaded marches followed by shooting.

From a theoretical perspective, the study might contribute knowledge on how cognitive strategies influence performance. Numerous forms of dissociation and distraction have been reported in the scientific literature. While a large number of techniques (e.g., staring at a collage, listening to a tape of street noise, etc.) have shown positive results only a select few of the techniques were multi-purpose. That is, not only could the dissociative technique remove the person's thoughts from the existing unpleasant activity but it also served as a relaxation technique (e.g., meditation; Morgan, Horstman, Cymerman & Stokes, 1983). By training individuals to dissociate in this manner, two important military concerns are addressed; ability to deal with pain and fatigue and ability to deal with mental stress (Allen, Chatelier, Clark & Sorenson, 1982).

Few studies if any, have examined multi-functional dissociative techniques in combination with an associative biofeedback strategy. For instance, soldiers who are well trained in dissociative (e.g., meditation) and associative strategies (e.g., biofeedback) may be able to deflect their attention toward more restful thoughts during simple prolonged operations. These thoughts may relate to an image or word that depict an enjoyable and relaxing feeling. Yet, if faced with an emergency, the individual may quickly return to task and focus on specific autonomic responses, i.e., appropriate muscle tension, heart rate, peripheral temperature, paced breathing, to perform certain military precision tasks (Lacroix, 1981).

Delimitations

The scope of this study will be delimited as follows:

1. The subject sample will be delimited to forty four male infantry soldiers at the Princess Patricia Canadian Light Infantry (PPCLI) base in Calgary, Alberta. The soldiers will vary in age from 20 to 30 years old and will

have no more than 6 years of military experience.

2. The study will be delimited to two tasks; the weight-loaded march and shooting.
3. The weight-loaded march will be performed inside a gymnasium to eliminate the possibility of adverse effects due to foul weather. As well, the shooting will be performed in an indoor shooting range to ensure proper temperature and lighting.
4. The rifles used for the shooting test will be delimited to four C1A1 Fabrique Nationale rifles with .22 calibre inserts and with rim-fire .22 calibre ammunition.

Limitations

1. The qualitative and self-report questionnaire results will be dependent on the subjects' honesty during the tasks.
2. As a result of the "in vivo" environment, several unpredictable variables emanating from military base surroundings may occur (e.g., Infantry troops may be required to serve elsewhere in the province, country, world, and accordingly the priorities are military duties, etc.).
3. The study will be subjected to time constraints from April 20 to May 15, 1991.

OPERATIONAL DEFINITIONS

Associative strategy- This refers to a mode of thinking in which the individual concentrates on critical physiological and/or technical demands during an activity (e.g., bodily focus or task oriented like concentration on pace, form, style, liquid intake, localized self-regulation and relaxation).

Attentional Focus - It consists of a cognitive process involving an individual's directing and maintaining awareness of stimuli as influenced by one's level of alertness and one's limited capacity to process task-related information at a particular point in time (Etzel, 1979, p. 282).

Battle Shot - A fit and trained soldier who can use ground for movement and fire, keep his personal weapon in action, detect the enemy, and shoot quickly and accurately under all conditions of combat (Department of National Defense, 1983, 1-4).

Biofeedback - A technique of using equipment (usually electronic) to reveal to human beings some of their internal physiological events, normal and abnormal, in the form of visual and auditory signals. These signals assist in teaching the user to manipulate some otherwise involuntary or un-felt muscles, organs or brain waves by manipulating the displayed signals (Basmajian, 1989).

Dissociative strategy - This refers to a mode of thinking in which the individual intentionally takes his cognitive awareness away from the activity in which he/she is currently engaged. In this study, it particularly applies to distracting the mind from bodily pains and fatigue resulting from the endurance match.

Electromyogram (EMG) - An instrument which quantifies and gives one or more feedback indications of electrical impulses resulting from muscle contractions at selected sites (Basmajian, 1989).

Infantry - The primary role of the infantry is to establish contact and destroy the enemy. The primary tasks of the infantry are: close range combat by day and night; reconnaissance and offensive patrolling by day and night; holding ground; and the close protection of armour. The infantry may be required to perform other tasks such as internal security, peacekeeping and assistance in civil authority. (Department of National Defense, 1980, 1-1).

Personal Weapon Standard - (PWS) The standards to be achieved and maintained by all ranks when firing their personal weapon. The ranks are "Marksman", "Pass" or "Failed" (Department of National Defense, 1983, 1-4).

Personal Weapon Test - (PWT) The test of shooting ability to be completed annually by all ranks below the rank of lieutenant-colonel firing their personal weapon (Department of National Defense, 1983, 1-3).

Range Safety Officer - (RSO) An officer, Warrant Officer or senior Non Commissioned Officer (NCO) who is given full responsibility to conduct live firing on a range. Qualifications for being an RSO consist of the following:

a) The individual must be qualified to use the weapon(s) being used in the exercise by virtue of either a formal Canadian Force course or a combination of unit on-job-training and experience which meets with the approval of his Commanding Officer (CO).

b) The individual must be knowledgeable and well informed of the current orders and procedures for range control and practice.

c) The individual must have demonstrated an aptitude to supervise and manage range practices (DND, 1981, 1-7).

Shooting Proficiency Levels - A soldier tested against his operational standard who achieves 70% of the highest possible score (HPS) on the PWT will be awarded a "pass". The individual who achieves 85% of the HPS or better will have achieved a "marksman" standard (DND, 1983, 1-5).

Skill-at-Arms Training - It involves the appropriate combination of weapon training, physical fitness and field craft required to produce a soldier who, under all conditions of combat, can with all hand-held weapons applicable to his Arm or Service, use ground, keep his weapon in action, locate the enemy and shoot rapidly and accurately (DND, 1983, 1-3).

Skin-Temperature biofeedback - An instrument which quantifies and gives one or more feedback indications of skin temperature at a selected site or sites via a thermister (Basmajian, 1989).

Sport Tester PE 3000 telemetry unit - It consists of an electrode belt, a transmitter and a receiver. These wrist-mounted units are designed to record the wearer's heart rate every 5 or 15 seconds and to keep it in memory. The data is then downloaded by means of an interface unit into computerized processing.

Zeroing - The term is used to describe a sight adjustment which represents "the steps taken by the firer, the coach and the armourer, to bring the rifle sights into position so that when accurately fired by the shooter for whom it has been adjusted, it will send the bullets to the centre of the aiming mark at 200 meters" (DND, 1983, 3-29).

Preliminary Stage of the Battle Shot (Grouping and Zeroing) - The training of soldiers must be based on their ability to group consistently to the required standards in all firing positions. Training should progress from small bore (5.6 mm or .22 inch calibre) where the basic weapon training lesson can be confirmed and faults corrected, to full bore (9 mm) at first 25 meters and then 100 meters. Ranges used for grouping should provide for rapid feedback on the location of hits and misses. No soldier should be permitted to zero his personal weapon until he can group to 200 mm (eight inches) at 100 meters, prone, supported. The infantry soldier must tighten his/her group to 150 mm (six inches) prior to firing from 300 meters (DND, 1983, 2-2).

STATEMENT OF THE PROBLEM

The central purpose of the research was to investigate the separate and combined effects of a dissociative strategy (meditation) and an associative strategy (biofeedback :EMG, heart rate & peripheral temperature) on sustained marching and shooting accuracy. In view of the literature review on sustained performance (weight-loaded march) and performance accuracy (shooting), the following specific research queries were formulated:

1. To examine the effects of meditation, biofeedback, and the combination of both on perceived fatigue, rate of perceived exertion, and perceived amount of time remaining while engaged in a marching task.
2. To examine the effects of meditation, biofeedback, and the combination of both on heart rate regulation when shooting and when marching.
3. To examine the effects of meditation, biofeedback, and the combination of both on shooting performance.

A subsidiary problem was to investigate the cognitive strategies presently employed by infantry soldiers. This investigation involved two aspects:

4. To identify the cognitive strategies presently used by infantry soldiers when doing a weight-loaded march in a confined area.
5. To identify the differences of estimated amount of time remaining in the weight-loaded march between the soldiers who reported predominant associative thinking and soldiers reporting predominantly dissociative thinking.

HYPOTHESES

The following research hypotheses were formulated according to the literature review.

Hypotheses one and two related to trial 1 only (first march and first shooting test). The first two hypotheses identified the sample subjects' natural cognitive strategies. This preliminary information was examined to determine whether or not the military personnel in the sample favored one strategy more than another and if so, its relationship to task performance.

Hypothesis 1

1. A greater number of subjects will use dissociative strategies than associative strategies during the first march.

Hypothesis 2

2. Those infantry soldiers who report predominantly using dissociative strategies will be less accurate at providing an estimated time remaining in the march than those who report using predominantly associative thinking.

Hypotheses three to seven were based on differences between Trial one and Trial two. It was hypothesized that the different treatment conditions would result in differential changes in performances across the two performance trials.

Fatigue and Rate of Perceived Exertion

Hypothesis 3a

3a. Subjects in the meditation and combined groups will experience less fatigue on trial two relative to trial one than will the biofeedback and control groups.

Hypothesis 3b

3b. Subjects in the meditation and combined groups will perceive a lower rate of exertion on trial two relative to trial one than will the biofeedback and control groups.

Hypothesis 3c

3c. Subjects in the meditation and combined groups will report a greater discrepancy in the amount of time remaining in the march on trial two relative to trial one than will the biofeedback and control groups.

Heart Rate

Hypothesis 4a

4a. Subjects in the biofeedback and combined groups will maintain a lower heart rate in the march of trial two relative to trial one than will the meditation and control group.

Hypothesis 4b

4b. Soldiers in the biofeedback and combined groups will be better able to self-regulate (lower) their heart rate during the shooting test in trial two relative to trial one than will the meditation and control group.

Shooting Performance

Hypothesis 5

5. Subjects in the biofeedback and combined groups will be more accurate during the shooting task in trial two relative to trial one than will the meditation and control group.

REVIEW OF LITERATURE

Introduction

With modern technology, it would appear reasonable to suspect that Army soldiers are no longer expected to perform the same amount of physical labor as they once were. Yet, though equipment has been modernized and miniaturized, more equipment is needed to protect soldiers from biological, chemical, conventional and nuclear warfare (Marston, Kubala and Kraemer, 1981). Also, with the discovery of night vision goggles, infantry soldiers may be expected to fight more frequently at night. The modern soldier must have the physical fitness and endurance to withstand longer periods of combat time with fewer rests and less sleep. In the way of combat "load carries", infantry soldiers are expected to transport a ruck sack weighing about 45% (33 kg) of their body weight during an approach march (Knapik, 1989). Because of the many extra unpredictable conditions, the required carrying load necessitates that soldiers be more physically fit than ever before (Marston et al., 1981).

A great deal of time, effort and money are invested on sophisticated multipurpose equipment. Like the equipment in many respects, infantry soldiers are trained to become fit, disciplined and multi-competent individuals who know how to make designated equipment work up to its potential, i.e., the infantry soldier can take weapons apart, rebuild them quickly and perform a designated task.

Interestingly enough, a great deal of the emphasis in military training appears to have been addressed to the external portion of the infantry soldiers only i.e., on their technical and military procedural skills. Such common duties as digging shell scrapes and casualty evacuation are important yet if a soldier succumbs to temporary physical pain or fatigue after a marching approach, the soldier, weapons and possibly the infantry unit may lose their potential operative capabilities upon arrival on the battle field. Furthermore, if soldiers are incapable of controlling their levels of excitability when nearing the enemy their technical military training may not be adequate i.e., shooting, following orders properly.

Recognizing the importance of mental control, the Canadian Directorate of Personnel Selection, Research, and Second Careers (DPSRSC) contracted two sport psychology consultants (Terry Orlick and John Partington) to develop a mental training program with the Canadian armoured regiment in Europe (Military Testing Association; 1987; Orlick and Partington, 1987). The training was directed toward two Canadian teams which participated in the bi-annual Canadian Army Trophy (CAT) competition. In 1985, the Canadian teams finished last in the NATO standings (18th and 20th out of 20 troops). The consultants developed their program under four main sections; Quality training, Refocusing plans, Pre-competition plans and Team building. After the program, both Canadian teams were highly successful placing first and third in the Leopard I tank category. Overall, when included with the more advanced tanks, the Canadian teams placed sixth and thirteenth out of a total of 24 troops.

Similar results were found in Boeselager, in 1988 (Partington, Orlick and

McCaffrey, 1988). The mental training program appeared instrumental in the Canadian teams' success. In working with small groups, a strong bond developed among team members and a self-motivational process resulted. However, when dealing with much greater numbers (platoons, brigades), the program becomes less convenient. As well, little was provided in the way of individual self-regulation.

A soldier should be capable of self-regulation in stressful situations. In fact, the "soldier's performance capability--his/her endurance--is one of the critical resources whose expenditure in combat must be carefully managed" (Kopstein, Siegel, Conn, Caviness, Slifer, Ozkaptan & Dyer, 1985, p. 41).

Minimal effort seems to have been directed toward the more personal "internal" aspect of soldiers, i.e., their mental set. A growing body of literature suggests that cognitive skills can in fact, improve sustained performance by lessening fatigue and physical discomfort (Fobes, 1986; Masters & Lambert, 1989; Morgan, 1978; Rejeski & Kenney, 1987). Moreover, with proper training, individuals can quickly learn to reduce their stress and tension levels, lower their heart rates and increase their trigger finger temperature for shooting, at will, without ever moving (Yee, 1988; Barton, 1981, Basmajian, 1989; Daniels & Landers, 1981). The benefits from this type of training are limitless.

This literature review is threefold. The first section will review the cognitive strategies available for lessening pain and improving sustained performance in combat soldiers. The second, will examine biofeedback procedures for improving shooting accuracy. The third will give an overview of the current approaches to military training.

The first section of the literature review will be subdivided into three parts. Firstly, the concept "attentional focus" will be reviewed. Secondly, two fundamental cognitive strategies will be contrasted in view of recent literature pertaining to attentional styles. Thirdly, modifications of the two styles will be examined.

Attentional Focus

Over the past few decades, mental training has become an increasingly important factor for facilitating peak human performance. Some authorities suggest that 60 to 90% of major sporting achievements occur as a result of individuals' abilities to train psychologically (Garfield & Bennett, 1984). In the area of endurance sports and military tasks, one of the more important cognitive factors of performance enhancement is the attentional strategy of the individual (Fobes, 1986). Attention is considered to be a cognitive process by which an individual directs his/her awareness to a particular sensory stimulus or cue (Martens, 1987).

Bird and Cripe (1986) present an interesting analogy. Attention is like a fixed electrical current in that only a certain amount of electricity (attention) can be allotted to a number of circuits (tasks). If more is attempted, a blown fuse results or in the case of sports, poor performance occurs. Selective attention allows the individual to direct the attention where it is most needed. By focusing only on one task, other extraneous thoughts and cues will be ignored. Depending on the individual, attentional styles will be displayed in a variety of ways.

Although a number of attentional theories of human performance exist, one of the most commonly applied to sport is that of Nideffer (1976; Canadian Coaching Association, 1983). Nideffer suggests that attention is a multifaceted construct capable of varying in scope (i.e., narrow v.s. broad) and in direction (i.e., internal v.s. external). These two dimensions combine to provide different attentional styles. For instance, a narrow-internal focus suggests that an individual attends primarily to his/her own bodily sensations. Broad external focusing suggests attention is oriented on a broad scanning of the surrounding environment. Nideffer suggests that different attentional styles are more advantageous for certain types of task performance.

For sustained performance (e.g., weight-loaded march, marathon), Nideffer (1976) suggests that a narrow-internal focus enables the individual to better tolerate pain and to improve endurance performance. He contends that distance runners and swimmers have the ability to "develop a particular thought or rhythm and then to lock onto it. This ability allows them to ignore a great deal of fatigue and pain, and it keeps them from developing self-defeating thoughts and attitudes (p. 50)." In contrast, Raiport (1988) proposes that many people don't reach their peak performance because they fear the pain. Raiport suggests that accomplished athletes are frequently individuals who have trained beyond the pain threshold and who are better aware of their physical and mental potentials. They are athletes who know to respect, monitor and work with painful elements (e.g., muscle and stomach cramps, headaches, light-headedness).

Although some controversy has arisen on whether or not an athlete should be aware of pain and fatigue (Raiport, 1980; Nideffer, 1976), a considerable amount of knowledge has developed to further delve into this field of cognitive strategies during sustained performances.

Cognitive Skill Strategies

As modern pioneers in the field of cognitive effects upon sustained performances, Morgan and Pollock (1977) investigated the cognitive strategies used by world-class marathon runners. They hypothesized that elite runners would tend to dissociate in order to avoid fatigue and the apparent excruciating pain of "hitting the wall". Much to their surprise, dissociation did not constitute the strategy of choice for the elite athletes. After interviewing the runners, Morgan and Pollock summarized five predominant points:

1) very close attention was paid to bodily input like the sensations from their feet, calves, thighs and respiration.

2) time pacing was very important and was governed by "reading the body"; e.g., "I know if I am beginning to hurt, the runners around me must really be in trouble, and so I just turn it on" (Morgan, 1978, p.43).

3) during a given race, runners preferred to run with certain other individuals if possible.

4) most runners did not encounter any "pain zones" like "hitting the wall"

during the race.

5) throughout the run, they remind themselves to "stay loose" and "relax"; i.e., "I not only pay attention to my body as I run but I also constantly remind myself to relax, hang loose, not tie up... that can be disastrous" (Morgan, 1978, p. 45).

On the basis of their research, Morgan and Pollock conceptualized two cognitive strategies, associative and dissociative styles, and concluded that world-class marathoners predominantly applied associative techniques to maintain their awareness of pain and discomfort in races. Subsequent to this study, numerous other investigators examined sustained performance in light of Morgan and Pollock's cognitive strategy findings (Gill & Strom, 1985; Masters & Lambert, 1989; Schomer, 1986, 1987).

Masters and Lambert (1989) examined 48 marathon runners by employing a questionnaire and a marathon race diary. Their results concurred with Morgan and Pollock (1977) suggesting that the majority of the runners (93.75%) chose to apply associative strategies.

Schomer (1986) explored the strategies utilized by 31 marathon runners of varying calibers. He recorded and documented marathon runners' thought processes while they ran. Runners who were equipped with micro-cassette recorders were asked to say anything that came to mind as they ran. Data was then classified according to Nideffer's theoretical construct of attentional focusing (see Appendix A). Schomer found a strong relationship between associative thinking and perceived rate of exertion for all levels of runners. The harder the run became, the higher the perceived exertion became and the more associative was the thinking. Although, Schomer (1986) did not suspect his data collecting strategy to be obtrusive, it can be argued that by reminding runners to speak into a micro-recorder, the athletes were indirectly required to focus on the task (i.e., associative thinking) in order to remember to speak in to the recorder. Therefore, the amount of dissociative thinking may have been minimized as a result.

In a follow-up study, Schomer (1987) examined the feasibility of a mental strategy training program for runners of varying abilities. He administered a five-week program with a forty-five minute intervention once per week, to 10 marathoners of differing capabilities. After this program, eight of the ten runners showed increases in associative thinking and in perceived exertion while running. On the basis of these results, Schomer contented that this form of training would allow runners to progress more safely and efficiently toward top performance. Porter and Foster (1986) also believe this to be an effective training alternative for future runners. They, like Schomer, feel that elite runners should acknowledge their discomfort and learn to utilize it "... rather than being disabled by it" (p. 62). Similarly, Raiport (1988) suggests that many athletes are held back from their peak performance by the fear of pain.

In summary, a number of researchers (e.g., Schomer, 1987; Bird & Cripe, 1986; Raiport, 1988) strongly subscribe to the notion that associating with body sensations improves endurance performance. In contrast, however a growing body of alternate research implies that dissociative or distracting thoughts can effectively enhance endurance efficacy in a variety of activities (Gill & Strom, 1985; Masters & Lambert, 1989; Padgett & Hill, 1989). This latter research will now be considered.

Dissociation

Dissociation is considered to be a strategy for separating the thoughts from an actual activity. For instance, instead of thinking about the slow incline up ahead, a marathon runner may mentally stray away into daydreaming. By the time the race is over, the runner may not be mentally fatigued by the race. This cognitive scheme would appear to be "far more pleasant, since it reduces anxiety, effort sense and general discomfort" (Morgan, 1978, p. 46). In Marathon running, it allows the athlete to persevere through temporary zones of boredom and discomfort (Schomer, 1986). However several researchers have cautioned against the use of a dissociative thinking style when marathon running for several reasons.

First, it is suggested that by overly dissociating, runners can disrupt their "running game plan" by purposely ignoring feedback from bodily sensations. For instance, the individual may begin too quickly or not finish fast enough (Morgan, 1978).

Secondly, it is observed that although not all pain signals should be heeded during a race, marathoners do "monitor their pain and take seriously the dangers that may lie ahead" (Newsholme & Leech, 1983, p. 58).

Thirdly, writers have cautioned that less-experienced athletes may risk "injury, heat stroke or heat exhaustion" (Morgan, 1978; Schomer, 1987). Such fears are based on the belief that dissociative strategies enable persons to selectively replace pain-related cues by other forms of distractions thereby exacerbating potential injuries due to higher fatigue and pain tolerance (Bird and Cripe, 1986; Rejeski & Kenney, 1987). For instance, while running, marathon athletes may be mentally imaging a pleasant scenery yet at the same time they may be overlooking a strained muscle, a sprained ankle, or dehydration.

Summers, Sargeant, Levey and Murray (1982) interviewed 363 novice marathoners and found that 69% adopted a dissociative strategy during training. Morgan (1978) found that elite runners also tended to employ dissociative strategies more frequently in training than in races. Summers et al. (1982) also note that during actual races, only 6% of the runners applied dissociation while 30.7% used association. The remainder of the sample (63.3%) could not classify their strategy in one mode or the other.

Newsholme and Leech (1983) recommend that an appropriate mixture of associative and dissociative thinking may be advantageous for elite runners. Associative strategies could be implemented at the beginning and near the end of the race to ensure an optimal pace or finishing kick. While dissociative thinking would be used during the middle part of a race to lessen mental fatigue. Theoretically, by doing so, marathoners would reap the benefits of both strategies.

A considerable amount of research has examined cognitive strategies with respect to marathoners. Other endurance activities will now be viewed.

Endurance Activities

Pennebaker and Lightner (1980) examined performance differences associated with focusing on internal and external cues. In their first study, subjects ran on a treadmill at a constant speed. Fifty seven subjects were assigned to one of three treatment conditions. One group listened to the amplification of their own breathing, one listened to distracting street noises and the third a control group heard nothing through their headsets. The subjects listening to traffic noises reported less fatigue and fewer discomforting symptoms than both other groups. The group listening to their amplified breathing reported the highest levels of fatigue symptoms.

In their second study, Pennebaker and Lightner (1980) divided 24 subjects into two groups. For ten days, subjects ran 1800 meters either on an exterior lap course or on a cross-country course. No between-group differences were found in reported fatigue levels. Yet noticeable discrepancies were scored in running times. They were much faster on the cross-country course than on the lap course. Pennebaker and Lightner (1980) suggest that cross-country course runners needed to be aware of the uneven trails with the occasional obstructions, i.e., roots, rocks, branches. Hence, they were required to externally focus more on their running paths for safety reasons. In Pennebaker and Lightner's view, the external focus led to faster times as it enabled more intense performance (i.e., faster running) before similar levels of fatigue to the control condition were perceived.

Padgett and Hill (1989) found comparable results with a similar study. Subjects rode a stationary bike for thirty minutes at a fixed speed. While one group attended to internal sensations as they rode, the other group focused externally on answering a survey. The latter group (distracted participants) performed significantly better than the associative thinkers. In a second study, track team athletes were divided into control, dissociation and distraction groups. Each individual was asked to run 1.6 km around a lap course. The dissociation group was asked to imagine something enjoyable throughout the run while the distraction group focused on the number of hurdles on the field, the number of cars in the parking lot, etc.. The control group listened to an essay as they ran. The results revealed the distraction group to be fastest, followed by the dissociative group and finally the control group.

Gill and Strom (1985) utilized a distraction strategy which required a narrow external attentional focus. They compared the differential effects of internal bodily focus and external focus upon a leg extension performance in a two-part study. Using two groups of 17 subjects each group performed leg extensions. While one group focused largely on their legs (internal focus) the second group attended to a collage, placed about one meter in front of them. Two days later, the order was reversed with group 1 using external focusing and group 2 focusing on bodily sensations. Following the exercises, subjects were asked open-ended questions about their thoughts and feelings during the exercise. This was done to ensure that the appropriate technique had been used throughout the exercise. Results evidenced external focusing to be the preferred technique by most subjects. Additionally, performance was significantly better with external focusing than with internal associative focusing.

In the previously reviewed studies, externally focusing improved performance. This may be explained by suggesting that while focusing on an external distraction, internal associative thoughts (i.e., fatigue, pain, boredom) are lessened.

An alternative explanation could be that people generally tend to seek a certain degree of change, novelty and unexpectedness (Couture, 1987). The street noise, the survey while cycling, the cross-country run and the 1.6 km run while focusing on extraneous cues all provided the impetus to cause variety. The variety (distraction) provided by Pennebaker and Lightner (1980) and Padgett and Hill (1989) were within a large environment thereby challenging the subjects to apply a broad external style of attention. Gill and Strom (1985) and Padgett and Hill (1989) in their first study, in presenting a form of novelty found comparable results with a narrow external attentional style, the collage and the interview while riding a stationary bike. Narrow internal styles will now be examined.

Internal Distractions

Although the dissociative strategy utilized by Gill and Strom (1985) was an external distraction (the collage), similar positive results with internal distractions were reported by Spink (1988). He examined the effects of dissociation and an analgesic suggestion. In dividing 36 subjects into three groups, dissociative,

dissociative/analgesic and control, each individual held one leg parallel to, and about 40 cm above the floor for as long as possible while sitting. As a dissociative strategy, the first group was asked to come up with their own mode of distraction (e.g., plan out a weekend), preferably a story and to use it during the entire leg-hold test. Following this instruction, they were told "We do not know what, if any, effect this technique will have on you while doing the leg exercise " (Spink, 1988, p. 100). In the dissociation/analgesic group, they were told:

> Recent research has indicated that the technique that you have been shown is a very effective method in reducing the discomfort and pain associated with endurance exercise. If you concentrate on your story, then you should feel a dramatic reduction in the amount of discomfort and pain experienced (p. 100).

Spink found that after a 15 minute training period, the dissociation/analgesic group improved significantly more in task duration than did the dissociative and control groups. Although less pain was reported, the differences were not significant.

In Spink's (1988) study, the combination group was provided with a rationale for performing such a cognitive exercise while doing the exercise task whereas the other groups were deprived of it. Averill (1973) stresses that perceived personal control is of utmost importance. By having subjects aware of the rationale for the treatment, their perceptions of threat are lessened. Other studies have also shown that subjects who were informed of potential effects tended to comply more to do exercise than subjects who were not informed (Martin & Dubbert, 1984; Wankel, 1987).

Rejeski and Kenney (1987) examined whether or not task complexity (i.e., mathematical calculations) made a difference in distracting attentional focus from fatigue. Sixty subjects were randomly assigned to 3 groups; a control group, a simple task and a complex task group. All subjects were asked to hold a hand grip dynamometer at 40% of the maximum for as long as possible. The results indicated that the two distraction groups could endure significantly more fatigue than the control group yet no difference was noticed between the simple and complex task groups. Internal and external distractions appear to benefit performance in endurance activities. However, some researchers have applied distractions that could be beneficial in a variety of situations, not only for sustained work.

Weinberg, Smith, Jackson and Gould (1984) examined the effects of association, dissociation and positive self-talk. In the first part of the study, four groups (three experimental groups and one control group) were evaluated according to heart rate, feelings, cognitions, and performance. The results showed no significant differences between any of the four groups when running as fast as possible for 30 minutes around a lap track. In their second study, a larger sample of subjects (N = 230) were divided equally into the same four treatment groups. The task was to maintain one leg straight, horizontal 40 cm off the floor while sitting on a wooden chair. The findings revealed that positive self-talk and dissociation produced significantly greater persistence than did the association and control conditions. Positive self-talk has also been effective for lessening anxiety and for nurturing a healthy attitude (Charlesworth and Nathan, 1984).

Morgan, Horstman, Cymerman and Stokes (1983) investigated the efficacy of dissociation, via a form of meditation, for improving endurance performance on a treadmill. In a pilot test, fifteen subjects were randomly divided into a dissociative group, a placebo group and a control group. The dissociative group was asked to use a pseudo-mantra "down" whenever each foot went down to the treadmill (i.e., down-down-down-down...). The placebo group members were asked to ingest a capsule (lactose capsule) which they were told would ease performance. The control group was not given any assistance. All subjects were tested on a treadmill run to exhaustion. The dissociative group was 19% superior to the control groups.

In the follow-up study, twenty-seven subjects were divided into a dissociative (meditation) group and a control group. Subjects were individually tested at 80% of their maximal aerobic power. The findings showed a 32% increase in endurance time for the group employing meditation. As with Spink (1988), Morgan et al. (1983) informed the meditation group about the rationale and advantages of complying with the training technique. As an introductory statement, the experimental group was told the following.

> "As you march today we would like you to try a technique known as "dissociation". Long distance runners from Tibet have run 300 miles

> nonstop in 30 hours using this technique and many Boston marathoners are known to successfully employ similar techniques."

Each subject was tested at 80% of their maximal aerobic power on a treadmill task. The findings showed a 32% increase in endurance time for the dissociative (meditation) group.

The use of meditation appears to be effective as a dissociative strategy. The repetition of a mantra, however, not only acts as a distraction but it can also assist in relaxing the performer. In the following section, meditation will be examined as a relaxation technique.

Meditation

Girdano and Everly, (1986) note that meditation may lessen the amount of self-talk which tends to "eliminate the surface chatter of the mind" (e.g., constantly processing thoughts). They contend that constant thinking of a mental device (a word or phrase referred to as a mantra) slowly brings the mind to rest by relieving it of the everyday hassles, joys, concerns. These so called distracting thoughts are eventually replaced by a state of deep relaxation.

Several types of meditation exist. Everly and Rosenfeld (1983) identify four types. Meditative repetition, one of the more commonly used techniques, entails dwelling on one mental device (i.e., the mantra) for an extended period of time. The mantra is silently repeated over and over. A variety of mantras exist depending on such factors as religion, culture, demographic regions, etc. For instance, Transcendental Meditation uses Sanskrit words, Benson (i.e., the

Relaxation Response) utilizes the word "one", some Tibetan Buddhist verses are employed (e.g., Om mani padme hum, wa guru). Delmonte (1983), in reviewing mantras within meditation, notes that any mental device, regardless of the source, which focuses attention inwardly is equally effective. A study at Harvard's Thorndike Memorial Laboratory found similar findings when Transcendental Meditation (TM) was compared to a variety of sounds and phrases. Both TM and the other mantras produced physiological changes, i.e., decreased rate of breathing (Benson, 1975). The second type of meditation presented by Everly and Rosenfeld (1983) consists of a physical repetition by which the focus of attention is directed toward a physical act such as breath control (Pranayama) or a variety of postures (Yoga). The third technique, problem contemplation, involves focussing attention on solving a problem that is paradoxical in nature (e.g., What sound does one hand clapping make?). In the fourth type, visual concentration, mental image is the focus of attention (e.g., a candle burning, a picture, a relaxing scene, etc.). Eastern cultures employ a "mandala" consisting of a square within a circle thereby representing the person within the Universe.

Everly and Rosenfeld (1983, p. 102) describe meditation as a continuum which includes

a) the start of meditation,

b) boredom,

c) distracting thoughts,

d) deep relaxation,

e) detached observation,

f) supraconciousness.

Although, the analogy of a continuum is used, Everly and Rosenfeld caution that the meditator may jump from one step to another in any order. Generally, the positive results tend to be experienced later than boredom and distracting thoughts.

To ensure successful meditation practices, Benson (1975) suggests four elements: A quiet environment, a mental device (a mantra), a passive attitude, and a comfortable position (sitting). When incorporating these elements, meditation has shown positive results in a variety of environments. For instance, Kabat-Zinn, Lipworth and Burney (1985) examined the effects of meditation with 90 chronic pain patients. After a ten-week training program, they found significant reductions in measures of present-moment pain, negative body image, inhibition of activity by pain symptoms, mood disturbance, depression and anxiety. In a follow-up study it was reported that the reductions had been maintained for up to 15 months.

Benson, Kotch and Crassweller (1977), in a review of 56 articles concerning the treatment of different pathologies reported that the Relaxation Response (a form of meditation) was found to be effective in dealing with hypertension, premature ventricular contractions, migraine headaches, and anxiety neuroses. Delmonte (1984a) tested 40 non-meditators and 12 experienced meditators and found that experienced meditators and first time meditators showed greater reductions in systolic blood pressure levels, heart rate, skin conductance level, and electromyogram than the control group. In the area of health in the work setting, a number of positive results were noted. Meditators were reported to have greater job satisfaction, improved performance, less desire to change jobs and better interpersonal relationships (Delmonte, 1984b; Frew, 1977).

Laarson (1987) examined the effects of three mental training techniques: meditation, progressive relaxation and imagery rehearsal, alone and combined on performance improvement with 214 Swedish army cadets. For eight months, the cadets trained with the assistance of platoon officers and audio tape-recorded programs. Although, some concerns were expressed by the cadets (i.e., the tape recorded programs were too structured), the mental training techniques were deemed "good" to "very good" by the subjects. The experimental groups, as noted by Laarson, improved significantly more than the control group in physical task exercises and in mental tests. The physical tasks were primarily concerned with antiaircraft artillery (i.e., learning to operate the lazer-guided antiaircraft missile) for one group and Morse code signals for the other.

While meditation has shown positive results in gross motor performances like marathon running and cycling, similar results were not found in fine motor tasks. Wood (1986) examined the effects of meditation on physiological responses by having 16 meditators and 16 non-meditators perform a fine motor task (pursuit-rotor tracking) and a gross motor task (Luft cycle ergometer). The findings revealed no significant differences in performance of fine and gross motor tasks. Similar results were found in studies investigating Transcendental meditation effects upon performance of fine perceptual-motor skills (Williams and Herbert, 1976; Williams and Vickerman, 1976). One explanation for these results may be that meditation has been shown to be an effective dissociative strategy (Morgan et al., 1983), a technique for swaying attention away from a task as oppose to increasing attention toward a task. As it appears that meditation does not improve fine motor tasks, it seems appropriate to examine other means for improving a task such as shooting.

SHOOTING

Introduction

In times of army warfare, it has been said that victories were more contingent on the quality of soldiers than on the calibre of their weapons (Rimland & Larson, 1986). Hence, the selection and training of military personnel is of major importance.

In the way of training, a good soldier is someone who is physically fit, able to carry out physically strenuous orders, read mercator grid maps, do drills and handle weapons (Smith, 1972). The proper handling of weapons is especially important since anyone in the military may be required to get him or herself, or others, out of a life-threatening situation in times of war. This responsibility relies heavily on the soldier being able to shoot accurately. Furthermore, soldiers are taught the technical skills of sharp shooting, in preparation for highly stressful situations where their physical and mental integrity may be menaced. Although a soldier may be a technically perfect rifleman, if the individual can't shoot with precision in times of distress because of anxiety or panic, the soldier and weapon lose their potential effectiveness. It is therefore crucial that soldiers be able to self-regulate their arousal levels when surrounded by a variety of uncontrollable stressors.

The purpose of this section of the literature review is to examine how biofeedback might influence physical and psychological factors to improve shooting accuracy. Initially, a physiological and psychological profile of elite marksmen will be described. Secondly, the technical shooting routine will be examined with respect to major psychosomatic components; heart rate, cardiac cycle and breathing pattern. Finally, the effects of biofeedback on shooting accuracy will be examined.

It has been said that soldiers should be provided with "effective tools to insure minimum deterioration of their performance on the job when they are in danger of being killed" (Keinan, 1988, p. 355). Such "effective tools", might include appropriate shooting technique and mental training for self-regulation as well as suitable weaponry. Because of people's idiosyncrasies, emphasis may be required on one, two or all three of the preceding "tools". The following literature review will concern itself primarily with mental training and self-regulation.

A number of studies have investigated the physical and psychological characteristics of shooters (Christina, Feltz, Hatfield & Daniels, 1980; Kelly, 1985). Yet little or no literature has been found dealing specifically with infantry soldiers and shooting accuracy. Consequently, the following literature review will be based primarily on sport shooters.

A Rifle Shooter's Profile

Physiological Characteristics

Generally in elite sports, body type constitutes an important factor in an athlete's success. For instance, in basketball and volleyball, it is preferable to have players who are very tall and lean, whereas in gymnastics the athletes tend to be shorter and more mesomorphic. In shooting, some common characteristics have been identified in elite marksmen.

Landers, Boutcher and Wang (1986) and Christina et al. (1980) looked at the demographic characteristics and somatotypes of shooters and found that elite rifle shooters tended to be more mesomorphic and stronger than the sub-elite. However, they noted that sub-elites fared better in such areas as hearing, vision and body fat composition.

In examining hand-eye dominance, Christina et al. (1980) observed that crossed hand-eye coordination (right-handed and left eye dominant, or vice versa) was two to three times more prevalent in the sub-elite group than in the elite group. To determine whether dextrality affected marksmanship, Sheeran (1985) examined the hand-eye dominance of 104 subjects. After creating equal groups of pure and crossed dextral subjects, he found that crossed dextral individuals, as a whole, were significantly poorer shooters (p<.05).

In an effort to investigate the importance of hand-eye dominance, Daniels and Landers (1982) selected 16 students with crossed hand-eye dominance from a sample of 100 subjects who were enrolled in a novice shooting course. The 16 subjects were divided into eye-dominant (the subject's preferred eye for visual focus) and hand-dominant (subject's preferred hand) groups. Eye patches were used by the hand-dominant group to avoid the use of the favored eye. The groups met for 75 minutes, three times per week for 10 weeks. They were taught a six-step shooting approach using the standard positions: prone, kneeling and standing. They used standard .22 caliber rifles with slings and shooting jackets. Grading was based on the 10 best prone shots; the 2 best kneeling shots and the best standing shot on a target worth a total of 100 points.

The results showed that the dominant eye group performed significantly better than the dominant hand group. On this basis, Daniels and Landers (1982) suggested that hand-eye dominance can be valuable in distinguishing elite from average shooters. Psychological elements have also been studied to identify the potential elite shooters.

Psychological Characteristics

When dealing with an activity that requires a high level of attentional focus, the slightest extraneous thought or emotion may result in large inaccuracies. Hence, several studies have examined anxiety and attention as they relate to marksmanship.

Doyle, Landers and Feltz (1980) in an attempt to identify the psychological skills of highly trained shooters, gave 184 elite and sub-elite rifle athletes the State-Trait Anxiety Inventory (STAI) and a descriptive questionnaire. The questionnaire covered such issues as training methods, anxiety, concentration, imagery and self-talk. Three key differences were found between the more experienced and the less experienced shooters. The most experienced shooters: were significantly less trait-anxious, demonstrated more self-confidence and were less bothered by mistakes made in competition and employed more imagery in training and in competition.

When asked to identify the two worst deterrents to shooting accurately, most of the 184 participants mentioned "nervous tension" and "inadequate preparation".

In investigating how elite shooters deal with nervous tension, several researchers examined the psychological characteristics of shooting athletes (Gould, Petlichkoff, Simmons & Vevera, 1987; Kelly, 1985; Landers & Daniels, 1982; Richards & Landers, 1980). Using Nideffer's Test of Attentional and Interpersonal Style (TAIS), Richards and Landers (1980) ascertained that elite shooters felt they had the ability to efficiently integrate ideas from a variety of areas. The experienced marksmen had lower scores in Overload attending to Extraneous external (OET) and Internal factors (OIT), and higher scores in Broad External (BET) and Broad Internal attention (BIT), Self-Esteem (SES) and introversion (Landers and Daniels, 1982; Richards and Landers, 1980). According to these findings, experienced shooters can regulate their attentional focus better than the inexperienced athletes.

Similar findings in self-esteem and introversion were detected, using the Eysenck Personality Inventory (EPI). Coleman (1980) measured extraversion of shooters in seven competitive shooting categories. Prone rifle shooters were found to be most introverted and least impulsive. It was felt that such characteristics enabled them to focus on a specific task more easily and more consistently.

In prone shooting, athletes must be fully aware of their physiology in order to ensure little or no movement from the body, externally and internally. Some research has examined the use of biofeedback to influence physical and psychological factors that improve stillness.

Psycho-physiological Factors During Shooting

Competitive shooting requires a great deal of fine motor control and concentration. Accomplished shooting athletes typically develop their skills through years of instruction, coaching and disciplined practice. Yet with a better knowledge of certain self-regulatory mechanisms (heart rate, breathing pattern through a mechanical feedback system), improvement can be accelerated (Daniels, Landers & Wilkinson, 1980). Biofeedback has been implemented in a variety of research projects to assist in self-regulating unsettled physiological components (e.g., racing heart rate, improper breathing pattern) that previously went unnoticed (Basmajian, 1989). With this added information, the athlete can focus accordingly on the ideal psycho-physiological template. Several studies have tested the importance of self-regulation on shooters' ability to shoot accurately.

Daniels et al. (1980) examined heart rate and the cardiac cycle of 62 elite and sub-elite rifle shooters to establish autonomic patterns of self-regulation in timing the trigger pull. In examining cardiac cycles, they noted that several shooters exhibited better performances when shots occurred late in the cardiac cycles ($p<.03$) as opposed to shots on the R-spike of the QRS complex. Similar results were found in other studies (Bird, 1987; Daniels & Landers, 1981).

When overall heart rate data was subdivided into six phases, Landers and

Daniels (1982) found the elite male shooter (N=18) profile to be the following:

Competitive HR = 83.6 b/m
Resting HR = 74.3 b/m
Average shooting HR = 85.4 b/m
HR Before breath hold = 95.0 b/m
HR During breath hold = 87.4 b/m
HR After shot = 93.1 b/m

In relation to the preceding findings, elite and sub-elite shooters' heart rates increased by 13% in a competitive environment over their resting level. Other findings suggest that an optimal pre-competitive shooting state can be achieved provided that athletes' heart rates do not escalate over 30% of the resting heart rate (Bird, 1987). These percentage differences, although substantial, may be attributed to different stress levels in varying competitive situations (e.g., preliminary shooting v.s. shooting finals).

Other studies have attempted to improve shooting accuracy by reducing cardiac rate via pharmacological means. For example, Kruse, Ladefoged, Nielsen, Paulev and Sorensen (1986) examined the effects of a β-blockade on pistol shooting performance. The drug metoprolol, a β-receptor blocker, was utilized. Chemically, it is thought to counteract catecholamines and cause a slower cardiac rate, a decrease in oxygen consumption and a reduction in cardiac output which may facilitate shooting stability and accuracy. In the Kruse et al. (1986) study, shooters improved their performance by 13.4%. No correlation however was found between shooting improvement and cardiovascular changes. The authors posited that metoprolol had a positive effect on hand tremor and accordingly improved shooting accuracy.

Other important modalities have also been examined. Breathing patterns were investigated in a similar manner as cardiac cycle and cardiac rate. Wilkinson, Landers and Daniels, (1980) examined the respiration patterns of 35 shooters across 40 rounds. A mercury strain gauge was utilized to measure shooters' chest movements and a microphone was attached to the muzzle of the rifle to record breathing pattern the instant the shot was fired. It was found that an "even" preparatory breathing phase before shooting, resulted in better performances than a progressively decreasing breathing pattern. Also, the investigators found that shooters' breath hold averaged 8.4 seconds and that performance progressively deteriorated the longer the breath hold was kept. In a case study, a proper breathing pattern developed via biofeedback increased an established shooter's score by as much as 13 points (Wilkinson et al., 1980). Similarly, some research has shown that shooting performance is associated with only moderate increases in Galvanic Skin Response (Bird, 1987).

Hatfield (cited in Landers and Daniels, 1982) tested 15 skilled shooters with an electroencephalogram (EEG). For top shooters (all right-handed) the EEG frequency of alpha brain wave patterns increased right up until the trigger was pulled. The alpha levels were found to be much lower when the subject was not in the process of shooting. With alpha waves normally representative of a alert relaxed mind (Basmajian, 1989), Hatfield theorizes that an hemispheric difference in alpha increases as the shooter prepares to pull the trigger. He notes that as the left temporal hemisphere increases in alpha waves, heart rate also goes up. With increases in alpha waves associated with relaxation and drowsiness and increased heart rate associated with nervousness or tension, such results lend support to a multifaceted construct of arousal.

As a follow-up study, Hatfield, Landers and Ray (1984) investigated the brain wave activity (EEG) of 17 shooters during performance. During the shot preparation, the left temporal and occipital alpha levels increased significantly while the right hemisphere activity remained constant. A significant shift was then made toward right brain dominance as the trigger-pull time approached. The authors speculate that this shift may be the result of elite shooters' acute level of attentional focus when on the verge of squeezing the trigger. Bird (1987) performed an exploratory study to determine whether EEG patterns were associated with levels of shooting accuracy. It was observed that when poor scoring shots were triggered, the EEG frequency of the left brain spiked up for a very short period. In contrast, when good shots were fired, the EEG frequency spiked downward. Such results lend support to the notion that mental relaxation tends to improve performance scores.

By harnessing the appropriate templates for EEG attentional focus, breathing pattern, heart rate and cardiac cycle for relaxation and stability, many sports as well as the Army could benefit. By better understanding the desired psycho-physiological attributes of skilled marksmanship, it may be feasible to train future prospective elite shooters in a much shorter time period.

Biofeedback

A great number of studies confirm the success of biofeedback applications in a variety of situations (Basmajian, 1989). Yet in the past, most of the attention concerning biofeedback has focused on pathology and symptomatology (Everly & Rosenthal, 1983). In recent years however, sport psychology has employed biofeedback as a means of relaxation training and for acquiring a better grasp of psycho-physiological self-regulation. The field is still relatively new as far as improving technical skills, health and performance are concerned. To better grasp the use of biofeedback, it is necessary to define and understand the theoretical framework.

Theoretical Framework of Biofeedback

Biofeedback is a collective word which, literally translated, suggests a method of acquiring physiological information about some part/s of the body. More precisely, biofeedback is a technique which generally utilizes electronic equipment with sensors and gauges. These instruments enable monitoring of some of the individual's internal physiological processes, in the form of visual and auditory signals. These signals assist in teaching the user to manipulate some otherwise involuntary or un-felt muscles, organs or brain waves by manipulating the displayed signals (Basmajian, 1989). The application of biofeedback can play a major role in providing athletes with a desired outcome through a process not fully understood. A number of different interpretations, ranging from the very simple to the very elaborate, have been offered for how biofeedback functions (Green and Green, 1989; Schwartz, 1989).

Schwartz (1989) suggests that the individual be viewed as a closed loop system in which the interactions between the brain, the body and the environment are examined. Schwartz uses cybernetics theory to describe the importance of the negative feedback loop. This loop enables the organism to continuously monitor and regulate itself. When errors and imbalances are detected, the information is transmitted to the Central Nervous System (CNS). Once the message has reached the CNS, the information can potentially be reassessed and corrections made to return the system to homeostasis by self-regulation. Schwartz uses the analogy of a thermostat in a home where changes in temperature, which may be above or below a level of comfort, would be monitored. This disregulation would be sent to the central monitoring device that either turns the system "on" or "off" accordingly.

In some situations, when the feedback loop is disrupted, the potential for poor motor performance is heightened in particular sporting activities (e.g., inappropriate heart rate, breathing pattern, muscle tension). The problem arises when athletes are unable to recognize and monitor the autonomic disruptions. To achieve an homeostatic state, Schwartz suggests that biofeedback opens the system via an external apparatus which allows proper monitoring and adequate self-regulation.

Daniels and Landers (1981) tested the closed-loop and disregulation theory by first examining the cardiac cycle, heart rate and breathing during rifle shooting and secondly by comparing biofeedback and verbal instruction techniques for developing awareness and mastery of autonomic functions. Daniels and Landers (1981) pretested eight male high level shooters to ascertain how the level of each athlete's heart rate and respiration patterns affected their performance. They were divided into two equal groups: auditory biofeedback and verbal instruction. The biofeedback group was constantly provided with auditory feedback on their heart rate and respiration patterns while the second group only received verbal instruction before the session without any feedback. Both groups practised for five sessions of 40 shots each. After training, biofeedback was no longer utilized and both groups shot two sessions of 40 rounds. The subjects were then asked, through a pre- and post- interview, whether or not they were cognizant and/or able to monitor their autonomic patterns. Significant improvements were noticed in the biofeedback group but not in the instructional group. The interviews revealed the experimental group to be much more sensitive to their physiological changes.

The eight subjects selected by Daniels and Landers (1981) had one of three disregulations; heart rate was too fast after shot; breath hold was greater than 9 seconds; shots were on the R spike of the QRS complex in the cardiac cycle. After the biofeedback training, performance and mastery of autonomic functioning significantly improved in the experimental group (auditory biofeedback). The authors attribute the success of the biofeedback treatment to increased somatic awareness. They interpret the results as supporting Schwartz's Closed Loop System theory of biofeedback.

In an effort to improve performance of fine motor skills, French (1980) examined the effect of tension control training, via electromyogram (EMG) to the frontalis muscle, on the acquisition and performance of a "pursuit-rotor tracking task". After pretesting 32 males on the pursuit-rotor (PR) task, three equal groups were formed: two experimental groups and one control group. Both experimental groups were provided with biofeedback training for nine 20 minute sessions of EMG training. Following the training, one experimental group performed the new PR task with the assistance of EMG while the other experimental group and the control group performed the task without assistance.

A significant difference was noticed in the reduction of tension related to the new PR task with the experimental groups. Both experimental groups had also improved their performance. French (1980) found no difference between the two experimental groups. Also, no improvement was incurred by the control group.

Shoot To Live

The "Shoot To Live" program, designed by the Canadian Army, addresses an important fact, the need to maintain and improve shooting proficiency (DND, 1989). The program's requirements are to train soldiers with the necessary skills to be consistent and accurate in shooting at any distance that may be effective with a personal weapon (i.e., the C7 rifle).

The program outlines several shooting progressions for soldiers, groups and/or teams to follow (DND, 1989, 2-1). It includes the following five phases:

Phase one - Preliminary (grouping and zeroing)
Phase two - Application of fire
Phase three - Personal Weapons Test
Phase four - Individual field firing (Infantry only)
Phase five - Collective field firing (Infantry only)

In this study, phase one was the primary concern. The preliminary stage requires the soldier to become adept at shooting a designated grouping size (size of the bullet hole groups on the target) from a variety of positions. Normally, training is initiated from 23 to 25 meters and it progresses up to 100 meters. Soldiers are not taught to zero their weapons till they are capable of producing a 153 mm grouping at 100 meters or 38.3 mm at 25 meters (a factor of .25) in a prone supported position which in turn, would represent a group of 305 mm at 200 m (two times the size at 100 m) or of 458 mm at 300 m (three times that of 100 m) (DND, 1983). Only then will the shooter progress to zeroing their C7 rifle.

Conclusion

The military environment is, in many respects like an athletic training centre. Soldiers are physically and technically trained there. However, unlike the sports camps, when competing, (attacking & defending), winning takes on an important difference, from winning or losing a prize to staying alive. As a result, psychological pressures may become crucial factors when considering accuracy.

Although there is a plethora of mental training strategies available, biofeedback is one of few that offers the user immediate feedback on its mental training effectiveness during practice. What took accomplished shooters years of training in recognizing the right internal feelings, the newcomer can learn in a matter of a few weeks (Daniels and Landers, 1981). With the continued advancement of biofeedback strategies in physical activities, self-regulation may improve military as well elite shooting.

METHODOLOGY

Subjects

This study was adjunct to a larger research project designed to develop a Mininum Physical Fitness Standard specific to the Canadian infantry[1]. One hundred and twenty male and 50 female soldiers from the Princess Patricia Canadian Light Infantry unit (PPCLI), stationed in Calgary, were made available for the larger study. For the present study, forty-four male infantry soldiers were selected from the larger group of 120 male soldiers. The subjects varied in age from 18 to 31 years (M age = 23.9 years) and had a range from 1 to 10 years of military experience (M age = 4 years). Their ranks consisted of 1 Sergeant, 4 Master-corporals, 12 Corporals and 27 Privates.

Procedure

Preliminary Participant Information

All test subjects were medically screened 3 weeks prior to the study (see Appendix N). Each individual received a testing advisory (see Appendix M) and was asked to complete a "Consent Form for Field Tests" (see Appendix O). The participants were assured of the complete confidentiality of any recorded data from this study. Subjects were free to ask questions before and after each physical task (i.e., marching and shooting). All questions were answered. Though the soldiers were informed of their freedom to cease their participation in this study at any time, they were encouraged to complete the tasks if possible. A light meal was recommended a few hours prior to the march. Each soldier was dressed in fighting order, i.e., a helmet, combat fatigues, webbing, rifle and a rucksack (Operations Plan Supply; OPS 150) with basic ammunition load totalling approximately 24 kg (Milner, date unknown).

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[1] Research project under the direction of Dr. M. Singh at the University of Alberta, Canada.

Preliminary Task Information - Marching

At the moment, the Canadian Forces employ a field test called the **Battle Efficiency Test** (BET) (also known as the "2 X 10" marches) as a means for measuring the soldiers' marching ability (Myles, Pope and Loon, 1985). It consists of one 16 km route march, in fighting order on two consecutive days. The soldiers are told to complete the first march in less than 2 hours and 45 minutes. It also includes climbing over a wall 1.8 meters high, jumping over a 2.35 meter ditch and doing a fireman's carry with another soldier for 200 meters. The next day, soldiers are required to perform the march in less than 2 hours and 30 minutes without the extra tasks. Myles et al., (1985) note that the BET measures one's ability to march in the infantry, yet results may vary considerably because of terrain and weather conditions.

Consequently the 16 km marches in this study were done at Currie Barracks in a gymnasium (Building CD-9, "Harvey Hall") located on the Calgary Base (PPCLI). The subjects were required to march at a speed of 5 km/h for 162 laps (see Appendix P). Every 30-40 laps, the soldiers were asked to change directions. The commands were "ON THE COUNT OF FIVE, YOU WILL

CHANGE DIRECTION. FIVE, FOUR, THREE, TWO, ONE, CHANGE AND MAINTAIN THE PACE". The pace was maintained by using a clock that would "beep" loudly every 38 seconds, at which time subjects were to be at the exact opposite end of the gymnasium from their original starting point. For example, soldier A began at pylon 16. In 38 seconds he was expected to be at pylon 8. Thirty-eight seconds later, he was to be at pylon 16 again. In the mean time, soldier B is always one pylon behind soldier A and so is the case for the remaining 13 soldiers.

The gymnasium's ambient temperature was maintained between 13°C and 17°C. Due to the lack of space, no more than 15 subjects marched at any one time; morning (9:00 to 12:00) and afternoon (14:30 to 17:30).

Sixteen pylons were located equidistant around the gymnasium to delineate the marching course as well as the distance between each of the 15 soldiers. All 15 subjects were identified by code numbers. The soldiers were allowed to drink water and juice when they wished. They helped themselves to water bottles (labelled with their names) from a table located at one end of the gymnasium. The water bottles were continuously replenished. Juices and pieces of oranges were also provided.

In the center of the gymnasium, a Medical Assistant (Master-Corporal K. Berry) and an extensive advanced first aid kit were available for soldiers who required medical attention (e.g., blisters, swelling, shin splints). A military ambulance was readily accessible from the gymnasium in case more drastic measures were required.

An attempt was made to have a minimal amount of interaction between subjects and the researcher during the march. As suggested by Morgan, Horstman, Cymerman and Stokes (1983), little motivational encouragement was given to avoid extraneous variables with motive incentives to perform maximally during the march. In this manner, the decision to stop was likely made by the subject.

Trial One

Prior to the start of the first trial, four designated subjects in each group of fifteen participants were asked to sign a consent form and answer one short questionnaire (Pre-march questionnaire, Appendix H). A PE 3000 Sport Tester belt, transmitter and receiver and a 24 kg ruck sack were placed on each individual. The rucksacks were weighed and accurate to within 250 gm. Barbell weights were added to those rucksacks weighing less than the required weight.

From the twelve marching groups of the larger project, four subjects (i.e., satisfying the sample group requirement; age, experience and rank) were selected from each group for this study. They were asked to report the following four types of data as they marched: Rate of Perceived Exertion (responses posted on a large chart), heart rate according to the Sport tester receiver, their Subjective Appraisal of Cognitive Strategies (SACS, potential responses posted on a large chart) and their perception of time remaining in the march. Subjects were asked to report this data every 12 to 15 laps around the gymnasium as they walked by the controller's table (see Appendix Q). For example at lap 12, a marcher reported "C, 140 minutes remaining", then on lap 15, the response was "6" for the RPE and 123 for heart rate (see Appendix R). The command signals were: "ON THE NEXT LAP, REPORT "A LETTER" and "TIME REMAINING" or "HEART RATE" and "RPE" . After three hours of marching, four subjects removed their packs at the coordinator's table and proceeded downstairs to the miniature indoor shooting range located in the basement of the gymnasium.

Preliminary Task Information - Shooting

The Harvey Hall Miniature Shooting Range was used for this study. For a high power rifle to be shot in an indoor range, an adapter (.22 calibre insert) is inserted. During this study, conversion kits for C7 rifles were not available at the Canadian Force Base (1 PPCLI) in Calgary. However, they were procurable for the Fabrique Nationale (FN) C1A1, the personal weapon used prior to the C7 (see Appendix X). Accordingly, the FN in combination with a .22 calibre insert was used for this study.

The four rifles used in the study were zeroed by the Range Safety Officer prior to testing to ensure that all rifles were equally accurate.

Conversion Kit

This adapter sub-calibre conversion kit, manufactured by Heckler Und Koch, enables up to 20 rounds of .22 rim fire long rifle rounds (.22 LR) to be fired from one magazine once installed in a standard 7.62 mm FN (DND, 1984). Once the conversion kit is completely installed, the FN C1 becomes an acceptable firearm for miniature indoor shooting ranges. In total, an additional 505 gms was added to the FN during the shooting exercise (see Appendix Z).

The FN Rifle

The FN was used as the infantry's personal weapon for the Canadian Forces until 1987-88 (Ebbet, 1990). This weapon is air-cooled and gas operated. As with the C7, it is magazine fed and self-loading yet unlike the C7, it fires 7.62 mm, capable of only 20 round magazines and is semi-automatic only (see Appendix Y).

Ammunition

Although a variety of 5.56 mm ammunition is available (see Appendix AA), .22 LR rounds are normally used for miniature indoor ranges (see Appendix AB). For the purpose of this study, only .22 rim fire LR lead round nose rounds were used.

All rounds shot in this study were made by Industrie Val Cartier Incorporée (IVI) and were from the same lot of ammunition to ensure consistency in round quality. Even though .22 LR ammunition is small, the potential for causing death or serious injuries is high. Consequently, indoor ranges are closely inspected and must conform to stringent regulations.

Shooting Range

In this present study, the Harvey Hall Range was used. It is a type II miniature indoor range with a firing point of 20 yards (DND, 1981, 14-18). Although the firing point is a two-tier platform construction, capable of holding eight prone shooters, only four subjects were allowed at any one time, to ensure a higher level of safety. Behind the firing point there was a table (95 cm X 210 cm) and four chairs, a stretcher and a first aid kit. During live firing, a large ventilating fan was in operation to minimize the amount of potentially hazardous fumes and lead contamination. In addition other precautions were taken to guard against the threat of lead residue (see Appendix AB).

The target holders consisted of four large thick pieces of bristol board (125 cm X 95 cm, white). The targets were pinned onto the bristle boards at a height of 150 cm from the floor. Behind the target holders was a projectile catcher. It consisted of a large concrete slab set at 45°. Directly below the slab was a large sand box to absorb and accumulate the lead projectiles. To protect shooters from potentially stray projectiles, the shooting range was equipped with safety baffles, suspended from the ceiling. These baffles consisted of a 3 cm boarding on an appropriate framing reinforced with 3 mm of steel plates. They extended to both sides of the range and were about 25 cm in width (DND, 1981, 13-54).

Range Standing Orders (RSO)

In the range, both RSOs strictly enforced the following Range Practice Procedures (Range Standing Orders, 1981, 14-10).

a/ Only those individuals authorized by the firing point officer are permitted at the firing point.

b/ Smoking is prohibited.

c/ Unnecessary conversation is prohibited.

d/ No person moves forward of the firing point until permission has been specifically granted by the officer in charge of the firing point.

e/ When weapons are inspected at the firing point, the weapons remain directed down range and, where possible, will be parallel to the ground.

f/ Weapon repair at the firing point will not be permitted until the offending weapon has been physically inspected by an authorized and qualified member of the firing point organization to ensure that it is unloaded.

g/ Drills for weapon handling will not deviate from those detailed in the applicable manual to the weapon being fired.

Targets shall be examined only when:

h/ All weapons have been unloaded and inspected by a qualified member of the firing point organization.

i/ No person is physically handling a weapon on the firing point.

j/ Authority to proceed in front of the firing point had been specifically given by the firing point officer.

For this study, the RSO (see Appendix AC) and a general duty (GD) "private" labelled the targets, gathered and showed the targets to the shooters, behind the firing point.

When firing live rounds, all occupants in the indoor range were required to wear properly fitting ear protectors/defenders. Once the targets were viewed by the subjects, they were scored.

Trial One

As soon as the four subjects arrived at the miniature indoor shooting range, they sat down and answered a perceived mental fatigue questionnaire (post-march, see Appendix I). The test took no more than 5 minutes to answer. Time was taken from the moment the subjects finished the march and headed for the range to when he began shooting to ensure some consistency between trial one and two. Soldiers took 8 to 12 minutes, from the time they removed the ruck sack to the time they shot their first round. If a soldier did not finish the march, he was timed and asked to make his way down to the range immediately.

After essential safety and procedural rules were outlined by the Range Safety Officer, the soldiers lay down on the elevated padded platforms (1.5 m), in a prone position, wore their ear defenders or ear protectors and waited for the RSO's orders to commence firing at their prospective targets. Two magazines (one with 15 rounds and one with 10 rounds) were then placed next to each subject. The following orders were given:

> THIS PRACTICE IS TWENTY-FIVE ROUNDS WITH FIVE ROUNDS ON EACH TARGET FROM LEFT TO RIGHT. FIFTEEN ROUNDS LOAD. TWO HUNDRED (rear sight aperture on the FN C1A1). AT YOUR OWN TARGET IN YOUR OWN TIME, FIRE (DND, 1981).

They shot twenty-five rounds knowing that the first five rounds were warm-ups. Five targets (9 cm apart) were provided for each soldier at a distance of 18.5 meters. Each target measured 11 cm in diameter with smaller circles measuring 8 cm, 4 cm and 2 cm respectively.

While shooting, the subjects were evaluated in several ways. First, a certified RSO/instructor examined and evaluated all soldiers' prone position according to an elaborate technical evaluation check list (Appendix E). This assessment served as a control measure to ensure that subjects had not significantly altered their prone posture (i.e., natural alignment, trigger pressure, recoil, muzzle jump, follow-through and breathing) from trial one to trial two. Secondly, heart rates were measured with Sport Testers as the soldiers shot. Every 15 seconds, average heart rate was recorded and kept in the memory of the Sport Tester's receiver. Finally, after shooting, both the weapon and magazines were individually checked for leftover rounds by the RSO. The subjects returned to the table to answer a self-report (post-shoot) questionnaire (see Appendix J). After answering the questionnaire, the RSO reminded the members that it is a federal offence to have live rounds or empty casings in their possession and asked every member in the room to make the following declaration:

> I HAVE NO LIVE ROUNDS OR EMPTY CASINGS IN MY
> POSSESSION, RSO (1/ MASTER-CORPORAL PICKELL,
> 2/ SERGEANT MORRIS).

Following the declaration, subjects returned the Sport Testers, were informed of their group letter (A, B, C or D) and their training schedule for the following weeks.

Every evening the RSO locked the range and returned the keys, ammunition, empty casings, rifles and cleaning rods to Range Control and to the Ammunition Store. The RSO made the two following written declarations.

1/ I CERTIFY THAT THE RANGE HAS BEEN LEFT CLEAN AND IN GOOD CONDITION.

2/ I CERTIFY THAT ALL UNEXPENDED AMMUNITION AND EMPTY CASINGS HAVE BEEN RETURNED TO AMMUNITION STORES AND THAT NO UNAUTHORIZED PERSON IS IN POSSESSION OF AMMUNITION OR EMPTY CASINGS (DND, 1988, 14-ONE-D-2).

Target Scoring

Except for the first five rounds of warm-up on target one, all four targets were scored according to their groupings as recommended in the Canadian Shoot To Live program (DND, 1983). Also, the soldiers did not "zero" (center) their FN C1 rifle prior to testing because of time constraints. The rifles were cleaned after every group of four subjects.

A number of target scoring techniques exist. While some targets offer calibrated circles of varying size, others have circles without the scores. The latter targets were utilized in this study primarily because there was no time for each soldier to zero the rifles before shooting.

The targets were scored by first identifying a four round grouping and then measuring in millimeters from center to center of the two farthest perforated holes (Morris, 1990). The "Shoot To Live" program notes that "a 'wild' shot in an otherwise adequate grouping should not be included in the grouping score (DND, 1983, 3-36). In compliance with the program, only four shots constituted a grouping per target for this study. Subsequently, the grouping sizes of all four targets were totalled and averaged. The average grouping constituted the individual's score (see Appendix AD).

As a rule of thumb, the "Shoot to Live" program suggests that the size of groupings can be quickly evaluated in the following manner:

If a dime can cover the group, the coordination is excellent.

If a small postage stamp covers the group, the coordination is good although there is room for improvement.

If half of a playing card or more is required to cover the group, then the coordination is poor.

This rule of thumb is applicable for either method of measuring groupings. In more specific terms, at a range of 20 m, the infantry should be capable of shooting a group of 25 mm, while other military personnel are required to shoot a 38 mm grouping in a prone position with their personal weapon, C7 (see Appendix AD; DND, 1989).

Trial Two

During the second trial, each marching group of 12 was divided into three sub-groups of 4 subjects. Each group of four soldiers wore a particular jersey color (red, blue, yellow or green) and began the march at staggered starts. For instance, the red group started the march at 8:00 and was followed by another four subjects thirty minutes later. Each subsequent group followed every thirty minutes. After 180 minutes of marching, the red group removed their rucksack and walked downstairs to the shooting range. Upon arrival, the routine in trial one was repeated (see Appendix K & L).

Mental Training

Between trial one and trial two, all forty-four subjects were divided into the four following groups: A/ a biofeedback group, B/ a meditation (dissociative) group, C/ a combined biofeedback-meditation, and D/ a control group. The subjects were randomly assigned to groups via a numbered card selection picked by the subjects during the march (see Appendix S & T). However, during the last days of the first march the officer in command informed the researcher that most of the soldiers in "A" and "B" company had to partake in a military drill in Suffield for the next two weeks. Therefore, the officer in charge of overseeing the logistics of the project, reassigned soldiers to different groups so that most of the personnel in "A" and "B" company would be categorized into the control group. The officer was not aware of which group letter corresponded with which of the three experimental groups.

For the next ten days, the experimental groups met once or twice a day for thirty to sixty minutes to practise preestablished routines (refer to the training schedule in Appendix F). For the biofeedback group, three to four subjects met with the researcher one hour per day. For the dissociation and combined groups, the group sizes varied between five and six at any one time.

Mental training was performed in two large classrooms in Keller Hall at Currie Barracks. Room #1 was designated for the biofeedback and combined groups while room #2 accommodated only the dissociation group. Both rooms were adequately separate to avoid the contamination of hearing other groups practise mental training.

In room #2, six large portable partitions were installed in the corners and at the ends of the rooms to provide a more suitable meditative environment. The cubicle-like spaces were supplied with comfortable chairs.

The noise level around both rooms was generally very low and the ambient room temperature was maintained at 18°C.

Room #1 contained four large portable partitions. Electromyograms and chairs were placed in three of the four corners. In each of the biofeedback and combined groups, subjects were asked to pair-up.

Group Descriptions

The biofeedback group subjects (N= 11) were trained to lower their electromyogram (EMG), heart rate, and increase their peripheral hand temperature.

Biofeedback Routine

The subjects were asked to complete a Consent form and Analog for Biofeedback (see Appendix D). They were then introduced to the three modalities as well as the rationale for their implementation. The EMG consisted of an Autogen 1700 model, accurate to 0.1 microvolt (see Appendix W). The band pass filter was set at 100-200 Hz on-line frequency to eliminate the majority of unwanted bands (Basmajian, 1989). The instrument provided visual and auditory feedback for the subject. The surface electrodes were located on the forearm flexors (primarily on the flexor carpi-radialis). This muscle group was selected because it serves as a support to hold the rifle up, in a prone shooting position. A pilot study with eight right-handed soldiers established the suitability of this muscle group for biofeedback training.

For the pilot study, subjects were asked to get into a prone shooting position on the padded platform firing point in the miniature indoor shooting range. They were then provided with an FN C1 and .22 LR insert combination. Their task was to hold an aiming position for 20 minutes and to describe where tension was felt every 60 seconds. This test was done under the supervision of the Range Safety Officer. All soldiers reported discomfort in the left forearm.

For most subjects, the left forearm was trained. Silver chloride electrodes were utilized in conjunction with Medi-Trace Electromedical gel. The preparation of the subject for the EMG consisted of initially wiping the subject's forearm clean with alcohol swabs (Premium Butterfly; Isopropyl Alcohol 70%). A dab of gel was then squirted into the center of the electrodes. The electrodes were then placed on the subjects' forearm in line with the medial epicondyle and the styloid process. The electrodes were held in place with small pieces of two-way adhesive tape with a circular hole (6 mm) in the middle.

Heart rate training was introduced in the third lesson (see Appendix F). The subjects were asked to sit quietly, and practise making their heart rate go down as low as possible (see Appendix V). The subjects were briefly informed about breathing regulation. Heart rate was monitored and trained via a Sport Tester receiver and transmitter. The wristband receiver provided visual and auditory feedback.

In lesson five, Biotic-bands were introduced into the training as the tools for identifying peripheral digital temperature (Appendix U & W). These lightweight shockproof bands consisted of two columns of temperatures (78°F to 94°F and 80°F to 96°F). Depending on the subject's finger temperature, a rectangular patch of liquid thermochromic crystals vary in color (visual feedback). To assist in raising their temperature, Autogenic Training was introduced (Luthe, 1965).

Starting on the seventh lesson, subjects were asked to assume a prone shooting position with no rifle while connected to the electromyogram. The heart rate and peripheral temperature modalities were still trained while sitting. On the eighth lesson, subjects were in the prone shooting position while all three modalities were integrated. They were asked to aim at a target while reducing tension in their forearm, lower their heart rate and increase their trigger finger temperature. On the ninth day, two subjects trained on the EMG while the other two subjects did short sprints of 50 metres then assumed the prone shooting position. Immediately they took aim on some targets, voluntarily reduced their heart rate and shot without ammunition three times within a span of a few minutes. On the last day, subjects concentrated on heart rate and peripheral temperature.

Meditation

The meditation group was taught a non-cultic meditative technique (Benson, 1975; Morgan et al., 1983) (see Appendix B & C). As with the first group, they were informed of the rationale for meditation in marching. Accordingly, subjects in this study were asked to imagine a relaxing scene. They were asked to make it as lifelike as possible by incorporating colors, smells, texture, etc. They were then asked to select a mantra (mental device) of their own. In their selection they were reminded to choose a word with no more than 2 syllables and preferably soft-sounding. Examples of their mantras included: comfort, sun, valley, snoopy, calm, cabin, home, mountain, alpine. For two days, only one session lasted 20 minutes per day. For the following days, two sessions per day were attended. During the ten days of meditation (sixteen sessions of thirty minutes) subjects were asked to answer the Competitive State Anxiety Inventory-I (Martens et al., 1981; see Appendix G) before and after meditation for six sessions to identify whether or not meditation was being performed and being useful. At the end of the tenth lesson, a short interview was done with each subject to inquire whether or not meditation was useful and applicable.

Combined Group

The third group was trained in biofeedback and in meditation. Initially, the subjects were familiarized with biofeedback in the same manner as the previous biofeedback group. Subsequently on the third day, they were asked to attend a second session to be introduced to meditation. Like both previous groups, they were told the rationale for biofeedback in shooting and meditation in marching. Biofeedback 1 lasted from forty to forty-five minutes in the morning and meditation lasted from twenty to twenty-five minutes in the afternoon.

Control Group

The control group was initially randomly selected yet when the group selections were complete, orders from the Commanding Officer requested that the groups be reshuffled so that some soldiers in "A" and "B" companies might go to the Suffield Army Base, Alberta, for some artillery field training. Consequently, the captain responsible for organizing the researcher's stay at PPCLI rearranged the four groups so that most of the soldiers in "A" and "B" company were placed in the control group. Eight soldiers of the control group were in this new selection and therefore were sent to Suffield.

Suffield is frequently used as a training site for a variety of military drills such as mechanized training, mine scouting, escape and evasion, mock wars. From April 30 to May 11, 1990, mechanized training was predominantly done (see Appendix AK). The two week training drill was labelled "Rolling Thunder". This mock warfare training was different for the eight control group soldiers. Two soldiers were responsible for maintaining a field store, delivering mail and ammunition crates. One soldier was a designated driver for the entire exercise. Five soldiers were labelled as riflemen. Their training and chores varied from section and company attacks to general and kitchen duty (see Appendix AK). In general, the control group soldiers described the Suffield training as being either mentally and/or physically tiring, and frequently unpleasant because of the weather this year (snow, rain, strong winds, big changes in temperature).

The two weeks of training in Suffield may have affected the fitness levels of the soldiers though three of the eight soldiers were not involved in any form of physical training. Consequently, five soldiers may have improved their weight-loaded march for this reason. Also, returning to garrison (Calgary Force Base) after the experience of Suffield may have been perceived as a restful time with the second weight-loaded march and shooting tasks as being less stressful than the first time.

Dependent Measures

The main dependent measures in the march were the following changes in perception from pretreatment to posttreatment:

a) rate of perceived exertion, b) levels of fatigue and symptoms of discomfort, c) perceived time remaining in the march and d) heart rates as they marched.

The main dependent measures in shooting were a) accuracy in performance, and b) heart rate.

Descriptions

Heart Rate

Heart rate has been used extensively to measure oxygen uptake and fitness levels (Astrand & Rodahl, 1977). It was selected for a measure of physiological exertion in the current study.

Each subject's heart rate was measured by a Sport Tester PE 3000 telemetry unit which consists of an electrode belt, a transmitter and a receiver. These wrist-mounted units are designed to record the wearer's heart rate every 15 seconds and to keep it in memory. The data is then downloaded via an interface unit into computerized processing. Subjects' heart rates were occasionally monitored by a researcher wearing a Sport Tester receiver to ensure proper heart rate [illegible]ngs. Furthermore, every 12 to 15 laps, subjects were asked to report their marching heart rate. This information was recorded in case the Sport Tester recording mechanism became faulty.

Rate of Perceived Exertion scale (RPE) (Borg, 1982)

A number of studies have included the Borg Scale, in conjunction with heart rate measures, to provide an estimate of the subject's appraisal of the work intensity. The RPE scale is a 15-point instrument ranging from 6 to 20. The instrument has several identifiers at every uneven number (e.g., 7 "very very light" and 19 "very very heavy"). It has been found to correlate linearly with heart rate (Pollock, 1989). In fact, the original concept of the RPE was developed with heart rate in mind. For instance, Borg's scale relates 6 to a resting heart rate of

60. A value of 9 would relate to a heart rate of 90 beats per minute (see Appendix R).

In the present study, the RPE was printed on a large cardboard and shown to marchers every 12 to 15 laps.

Subjective Appraisal of Cognitive Strategies (SACS) (Appendix A)

The instrument consists of ten categories, in which each descriptor relates to a specific cognitive attentional style (associative or dissociative). Schomer (1986) presents some evidence for reliability and validity. This was examined in the following manner. From 109 recordings taken four times per month while marathoners ran, 62 were deemed as representative by runners. The transcribed recordings lasted from 45 to 120 minutes. Schomer (1986) inspected the scripts for "recurrent thoughts on task-related and task-unrelated material". Categories were proposed and rationalized based on a "pronounced attentional focus". Reliability and validity of ten subclassifications emerged (Schomer, 1986).

A pilot study with ten infantry soldiers was conducted by the present investigator to examine the construct validity of the categories as outlined by Schomer. For military personnel, it indicated that comprehension of the subclassification titles was poor. Consequently, the titles were re-worded in more of a military context although efforts were made to use the same content and examples employed by Schomer (1986) in his description of the subcategories. Efforts were also made to respect the categories of attentional focus i.e., narrow-internal, broad-external. When asked if the modified version of Schomers' subclassifications were understandable according to the original descriptions set by Schomer, all ten soldiers individually replied favorably. For instance, Schomer utilized "Body monitoring" while this study used "How certain parts of my body feel". It is the investigator's contention that reliability and validity would not be greatly affected since the contents of each classification as outlined by Schomer (1986) were respected.

Subjective Appraisal reports were collected in the same manner as RPE.

Perceived Time Appraisal. (Padgett & Hill, 1988).

Every time both cardboards (RPE & SACS) were shown, participants were asked the amount of time remaining in the march. This procedure is believed to assist in identifying dissociators during sustained performances (Padgett & Hill, 1988). Consequently, all subjects were asked to remove their watches. There were no clocks in the gymnasium.

The self-report questionnaires asked the subjects to categorize their thought processes during the march and to identify their type of mental preparation (if any) for shooting. This was done to "identify individuals who might have used a coping strategy on their own, an obvious contaminating variable" if this was found in the control group (Rejeski and Kenney, 1987, p. 68).

Design and Analysis

The experimental design for the study was a pre and post test 4 X 2 factorial design (Campbell and Stanley, 1966). The four levels of the first factor "treatments" were three experimental groups, (biofeedback, meditation, combined biofeedback-meditation) and a control group. The two levels of the second factor were trial one (pretest) and trial two (post-test). The statistical analyses for hypotheses three through seven were 4 X 2 repeated analyses of variance.

Support for these hypotheses will be evidenced by a significant treatment X time interaction. Once a significant interaction was confirmed, a post hoc multiple comparison was performed using the Tukey method.

For the first two hypotheses no treatments were involved. Hypothesis one pertaining to the relative frequency of using associative and dissociative strategies was investigated by a Chi Square analysis.

Group Cells	TREATMENT											
Days	TRIAL 1	1	2	3	4	5	6	7	8	9	10	TRIAL 2
Biofeedback												
Meditation												
Combined												
Control		NO TREATMENT										

Figure 1. Experimental Design For The Intervention Format of the Study.

Dependent Variables	WEIGHT-LOADED MARCH							
	TREATMENT GROUPS							
Time (tests)	Biofeedback		Meditation		Combined		Control	
	T1	T2	T1	T2	T1	T2	T1	T2
Perceived Fatigue								
Perceived Exertion								
Time Estimate								
	SHOOTING TASK							
Heart Rate								
Performance								

Figure 2. Experimental Design For The Intervention Aspect of The Study.

Hypothesis two pertained to accuracy in estimating time remaining in the march by soldiers using dissociative strategies relative to those using associative strategies and was investigated by an independent student "t"-test. In both portions of the analytical process, a significance level of .05 was deemed as being statistically acceptable.

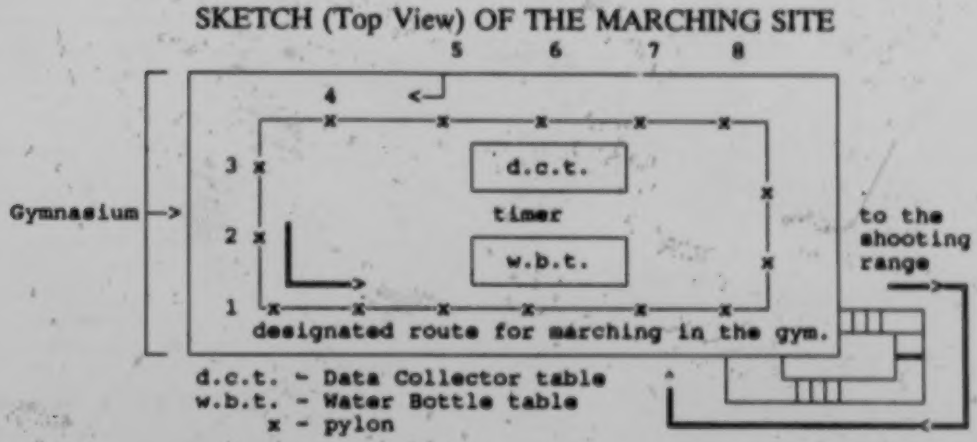
SKETCH (Top View) OF THE MARCHING SITE
5
6
7
8
4
3
2
1
Gymnasium
d.c.t.
timer
w.b.t.
to the shooting range
designated route for marching in the gym.
d.c.t. - Data Collector table
w.b.t. - Water Bottle table
x - pylon

Figure 3. Schematic representation of the testing site.

Group B (soldiers 5 to 8) are in position to begin the march. Immediately after soldier #4 passes the pylon next to #5, #5 begins, followed by the others.

RESULTS AND DISCUSSION

The following chapter presents and discusses the quantitative results organized around the stated scientific hypotheses. The first two hypotheses were based on trial one only (the first weight-loaded march and shooting test). Both inquiries served to ascertain the existing cognitive strategies of the subjects prior to any treatment intervention. Chi Square analyses were used to determine if subjects differed significantly in their frequency of use of associative and dissociative strategies during the initial marching and shooting trials. T-tests were used to investigate hypothesis two which applied to the accuracy in estimating time remaining in the weight-loaded march by subjects using dissociative strategies relative to those using associative strategies.

The data for hypotheses three through seven were analyzed via two-way analyses of variance with repeated measures. The data was analyzed in terms of four experimental groups by two time trials (before and after mental training). Due to a large number of two-way ANOVAs calculated in the study, there is an increased potential for a Type 1 error, therefore, caution must be exercised in interpreting the results.

Tukey post hoc procedures were utilized to identify which specific group means were different when a significant simple interaction effect resulted (Kiess, 1989).

Hypothesis 1:

During the first march a greater number of subjects will use dissociative strategies than associative strategies.

Results:

A Chi-Square test was used to test this hypothesis. Four soldiers completed less than 50% of the task and thus were not included in the Chi Square calculation. From a total of 40 soldiers, 18 utilized associative strategies while 22 utilized dissociative thinking. Although more dissociative strategies were utilized, the proportions of soldiers utilizing each strategy did not differ significantly (p=0.52). Hence, the first hypothesis was not supported.

Discussion:

Contrary to what was expected, more soldiers did not utilize dissociative thinking strategies as shown in other research. For instance, though Summers, Sargeant, Levey and Murray (1989) found that the mental attitude/drive appeared to be different when marathon runners raced and when they trained, it was expected that soldiers would see the weight-loaded march as a form of training like marathoners who tended to dissociate more during training (69% in a population of 363 runners). Summers et al. (1982) also observed no clear preference for either style amongst runners during a marathon race. They found that 63.3% of 363 novice marathoners could not categorize their strategy as being one or the other. These results are congruent to those reported for marathon runners in other research (Morgan and Pollock, 1977; Masters and Lambert, 1989).

An alternate explanation might be that some soldiers perceived the march, surrounded by fellow spectator soldiers, as being a competitive task while others did not see the importance of the task. Similar results were noted as Master and Lambert (1989) found that associative strategy was related to faster performances in running. As well, they found that the degree of drive for competition and the use of association increased proportionately. This may explain why some soldiers used more associative thinking to improve performance while for others, dissociative thinking was preferred. This was also observed as Schomer, (1987) described how a high percentage of marathon runners tended to use associative strategies to perform at their peak level during races. Runners reported focusing on their pace, breathing, muscular tension, pain, etc. as a means of self-regulation which would allow them to complete the race in good time.

Although marathon running and weight-loaded marching are different tasks they both demand physical and mental endurance.

Hypothesis 2:

Infantry soldiers using predominantly dissociative strategies will be less accurate at providing an appraisal of estimated time remaining in the weight-loaded march than will associative thinkers.

Results:

To test the hypothesis that dissociative thinking lead to less accurate time estimates, soldiers were termed as having a dissociative tendency if they reported dissociative thoughts 51% of the time or more (six times out of eleven responses) when asked throughout the march. Soldiers, labelled associative thinkers ($\underline{n}$= 18), averaged a total time discrepancy of 95.38 minutes ($\underline{SD}$= 40.373) while the dissociative group ($\underline{n}$= 22) totaled a mean time discrepancy of 98.31 minutes ($\underline{SD}$= 71.35). In other words, soldiers using associative strategies were more accurate in estimating the correct amount of time remaining in the march than those using dissociative strategies. An independent "t" test revealed that these means were significantly different T(38) = 3.12, p = 0.02. As hypothesized, subjects using more dissociative strategies were significantly less precise in their estimates of marching time remaining in the task compared to those using associative strategies.

Discussion:

As expected, soldiers who applied cognitive dissociative strategies were less accurate in estimating the amount of time remaining in the march. These results substantiate the theoretical definition of dissociation as referring to any strategy that will distract the individual's perception and physical experience of the task.

Similar results were found by Padgett and Hill (1988). In their first study, distracted stationary cyclists answered a survey as they cycled and perceived a thirty minute ride as being significantly shorter (p< .0001) than did undisturbed stationary cyclists. In this observation, the distraction appeared to reduce the perceived time taken in the endurance task. Unlike Padgett and Hill's subjects, soldiers were asked to estimate the amount of time remaining as opposed to the amount of time the exercise took once the task was completed. Dissociative soldiers expected the march to last longer than it actually did. Hence if they estimated time remaining as longer, time must have passed more quickly for them thereby resulting in less fatigue or boredom.

This phenomenon may be noticed for instance when driving a vehicle. A person driving a long distance, may from time to time daydream or think of a recent event. While preoccupied with these thoughts, the individual may still react in an alert manner if an emergency occurs, yet when the driver redirects attention to the road, a surprisingly long distance may have been travelled. Unknowingly, the individual may still think the destination is a few hours away when in fact only twenty minutes remain.

The next hypotheses were based on the differences between trial one and trial two to determine if biofeedback, meditation or a combination of both would generate a change in perception and/or performance.

The results pertaining to hypotheses three to seven are summarized in two tables. All tables labelled with "(i)" report the descriptive statistics of the four group during both trials. Tables with "(ii)" present the analyses of variance. The discussions are presented following all results of the principal hypotheses (i.e., after results of hypotheses 3a, 3b and 3c, 4a and 4b, and 5.

FATIGUE, RATE OF PERCEIVED EXERTION AND TIME ESTIMATE

Hypothesis 3a:

3a. Subjects in the meditation and combined treatment groups will report less fatigue in the second trial than will the biofeedback and control groups.

Results:

In examining the difference between trial 1 ($\underline{M}_1 = 230.00$) and trial 2 ($\underline{M}_2 = 238.33$), soldiers in the treatment condition perceived the second march as being more fatiguing than the initial march. The least drastic changes were found with the biofeedback group ($\underline{M}_1 = 201.50$, $\underline{M}_2 = 204.00$) while the biggest changes were evidenced for the meditation group which increased from $\underline{M}_1 = 194.54$ to $\underline{M}_2 = 283.63$ within the span of 22 days in garrison. As well, the combined group perceived the second march as more demanding from $\underline{M}_1 = 138.50$ to $\underline{M}_2 = 179.00$. In contrast to the treatment groups, the control group showed a substantial reduction in perceived fatigue across the two trials ($\underline{M}_1 = 374.54$, $\underline{M}_2 = 278.18$).

The results also showed large standard deviations for all groups suggesting a very wide range of scores.

The combined and biofeedback groups had mean perceived fatigue levels of 158.75 and 202.75 respectively over the two trials while the meditation and control groups had mean scores of 239.09 and 326.36 respectively.

The analysis of variance in Table 3a(ii) revealed a significant interaction effect $\underline{F}(3,38) = 4.38$, $p = 0.02$ between the biofeedback, meditation, combined and control groups from trial one to two. A post hoc Tukey analysis comparing each group cell identified only the control group as being significantly different from trial one to trial two.

Its mean of perceived fatigue levels dropped from $\underline{M}_1 = 374.54$ to $\underline{M}_2 = 278.18$.

Results also showed significant between group differences $\underline{F}(3,38) = 3.24$, $p = 0.03$.

TABLE 3a(i)

Descriptive Statistics for Four Treatment Groups' Perceived Fatigue During The March Across Two Trials

	GROUPS	TRIAL 1		TRIAL2		AVERAGE	
		M	(SD)	M	(SD)	M	(SD)
1	BIOFEEDBACK	201.50	161.28	204.00	129.97	202.75	145.63
2	MEDITATION	194.54	103.19	283.63	163.42	239.09	133.31
3	COMBINED	138.50	103.17	179.00	144.12	158.75	123.65
4	CONTROL	374.54	142.29	278.18	166.78	326.36	154.54
	AVERAGE	230.00		238.33			

TABLE 3a(ii)

Two-Way Analysis of Variance (Group X Trial) on The Perceived Fatigue During a Weight-Loaded March

Between Subject Factors (Groups)	Biofk	Medit.	Comb.	Control	
Within Subject Factors (Time)	Trial 1 Fatigue		Trial 2 Fatigue		
Source	Sum of Squares	DF	Mean Square	F Ratio	Prob.
Group	317965.56	3	105988.50	3.24	0.03 *
S-Within	1242584.00	38	32699.57		
Trial	1671.60	1	14.43	0.00	0.63
Group x Trial	97169.93	3	32389.97	4.38	0.02 *
B.S-Within	280467.00	38	7380.70		
Sig. Level * 0.05 ** 0.01					

Hypothesis 3b:

3b. Subjects in the meditation and combined groups will perceive a lower rate of exertion in the second trial than will the biofeedback and control groups.

Results:

The results pertinent to this hypothesis are summarized in Table 3b(i) and 3b(ii). All groups dropped in perceived rate of exertion from trial one (97.64) to trial two (89.00). However, the meditation and combined groups only differed by 1.1 and 6.1 respectively. The biofeedback and control groups, however, dropped by 4.7 and 8.63.

The analysis of variance of the perceived exertion scores of the four groups across both trials revealed no significant main or interaction effects.

TABLE 3b(i)

Descriptive Statistics on the Perceived Rate of Exertion for Four Treatment Groups During The March Across Two Trials

	GROUPS	TRIAL 1		TRIAL 2		AVERAGE	
		M	(SD)	M	(SD)	M	(SD)
1	BIOFEEDBACK	83.80	41.91	79.10	36.70	81.45	39.31
2	MEDITATION	84.46	30.50	83.36	34.73	83.91	32.62
3	COMBINED	92.90	38.37	85.90	31.81	89.40	35.09
4	CONTROL	97.64	37.40	89.00	25.72	93.32	31.56
	AVERAGE	89.76		84.43			

TABLE 3b(ii)

Two-Way Analysis of Variance (Group X Trial) on The Perceived Rate of Exertion During the March

Between Subject Factors (Groups)	Biofk	Medit.	Comb.	Control	
Within Subject Factors (Time)	Trial 1 Exertion		Trial 2 Exertion		
Source	Sum of Squares	DF	Mean Square	F Ratio	Prob.
Group	1802.64	3	600.88	0.27	0.85
S-Within	84223.56	38	2216.41		
Trial	601.24	1	601.24	2.84	0.10
Group x Trial	168.07	3	56.02	0.27	0.85
B.S-Within	8032.63	38	211.39		
Sig. Level * 0.05 ** 0.01					

Hypothesis 3c:

3c. Subjects in the meditation and combined groups will report a greater discrepancy in the amount of time remaining in the march in the second trial than will the biofeedback and control groups.

Results:

The results pertinent to this hypothesis are summarized in Table 3c(i) and 3c(ii). All group scores plunged from trial one to trial two. Contrary to what was expected, the meditation and combined groups had the least amount of change from trial one to trial two with score differences of 42.36 and 21.70 respectively. The biofeedback and control groups showed differences of 69.20 and 56.00.

A two-way analysis of variance on the results showed no group main effect or group X trial interaction effect. There was, however, a significant change across trials, $F(1,38) = 17.91$, $p = 0.001$.

TABLE 3c(i)

Descriptive Statistics For Four Treatment Groups On the Perceived Amount of Time Remaining in The March Across Two Trials

	GROUPS	TRIAL 1		TRIAL 2		AVERAGE	
		M	(SD)	M	(SD)	M	(SD)
1	BIOFEEDBACK	121.50	72.26	52.30	33.06	86.90	52.66
2	MEDITATION	95.82	95.82	53.46	48.15	74.64	72.00
3	COMBINED	77.40	41.92	55.70	23.90	66.55	32.91
4	CONTROL	112.46	74.90	56.46	59.17	84.46	67.04
	AVERAGE	101.91		54.50			

TABLE 3c(ii)

Two-Way Analysis of Variance (Group X Trial) on The Perceived Amount of Time Remaining in the March

Between Subject Factors (Groups)	Biofk	Medit.	Comb.	Control	
Within Subject Factors (Time)	Trial 1 Estimate		Trial 2 Estimate		
Source	Sum of Squares	DF	Mean Square	F Ratio	Prob.
Group	5514.98	3	1838.33	0.71	0.55
S-Within	98530.94	38	2592.92		
Trial	46908.14	1	46908.14	17.91	0.001 **
Group x Trial	6469.17	3	2156.39	0.82	0.49
B.S-Within	99526.06	38	2619.11		
Sig. Level * 0.05 ** 0.01					

Discussion:

The results for hypotheses 3a, 3b and 3c were not consistent with the hypotheses based on the review of literature. Contrary to expectations, the meditation and combined groups did not report significantly less fatigue, perceive less exertion or have a greater estimated time discrepancy than the biofeedback and control groups. Several possible explanations are discussed.

The first possible explanation for these inconsistent results may be that soldiers were accustomed to one particular type of cognitive strategy when marching (associative, dissociative or both). If the strategy they were asked to perform during the march was different from the one they normally employed, then it might have been difficult for them to internalize the new strategy. Hence some mental techniques might not have been appropriate for some soldiers when performing sustained weight-loaded marches. Rejeski and Kenney (1987) caution that this sort of problem does arise in this area of research by noting that "coping style preference might well be operative as a nuisance variable" (p. 69). This contention is supported by other research.

Sachs (1984) for instance, instructed marathon runners to utilize one of three designated cognitive strategies, associative, right-brain dissociative (e.g., thinking of music, painting, colors, etc.) and left-brain dissociative thinking (e.g., problem-solving, counting, current issues, etc.) during their race. When asked about the quality of the run, most of the replies were neutral or negative. Sachs (1984) lists some of the comments of runners who responded unfavorably to contrived thought processes. One of the runners stated that "I was glad I didn't have to count anymore. The forced strategies had become a real intrusion into my private hour". Another runner said "I don't use any other strategy really because I have been running for a few years and my thought processes are locked in (p. 294)." Sachs (1984) speculates that dissociative strategies might be more appreciated if they were introduced during training runs as oppose to more important races. Other studies have also examined cognitive strategies with less important runs yet results were still not encouraging.

Weinberg et al. (1984) divided forty subjects into four groups; associative, dissociative, self-talk strategies and control group. While all subjects ran for thirty minutes around a quarter-mile track, as fast and as far as possible, all experimental groups were asked to use the strategy introduced to them by the investigators. Weinberg et al. (1984) measured heart rate, feelings and cognitions and also found no significant differences between groups. They also suspected their subjects' lack of compliance with designated cognitive strategies.

An alternative approach might be the manner in which Pennebaker and Lightner (1980) examined different cognitive strategies. In their research, it was found that subjects ran faster on cross-country trails than on running tracks. Although there were no differences in fatigue levels, the following explanation was put forth that attending to the "external environment reduced the runners' awareness of internal sensations" (p. 171). Padgett and Hill's (1989) research also supported improved sustained performance with subjects attending to an external stimulus.

Padgett and Hill (1989) and Pennebaker and Lightner (1980) present research which suggests that the inverse of Weinberg's et al (1984) findings may be true. In other words, the pattern of equal fatigue with differing pace can be inverted to a pattern of equal pace and differing fatigue. This pattern was shown in Morgan et al.'s (1983) study. After quickly instructing soldiers to say "down" inwardly every time their foot went down to the treadmill, a 32% improvement was noticed in endurance time for dissociators. Unlike Morgan et al.'s study, the subjects in the current study, selected their own mantra (according to criteria) and practised meditation for ten days. Also, instead of walking on a treadmill till exhaustion, soldiers in this study marched for three hours with a weighted ruck sack at a set pace.

Morgan et al. (1983) required soldiers to use a pseudo-mantra during the treadmill walk to induce a cognitive dissociative strategy. Hence a form of meditation was performed by the subjects. Since positive results were noticed with meditation in Morgan et al.' study, it might be suspected that meditation in the present study was not learned. To ensure that subjects did, in fact, learn the meditative strategy, to a certain extent, all soldiers who were taught meditation (the meditation and combined groups) were asked to answer the Competitive State Anxiety Inventory (CSAI) Form 1, (see Appendix G) a short ten item self-report questionnaire, immediately before and after meditating. Items such as I feel "calm, nervous, secure, tense, etc." were measured on a five point

Likert-type scale. Each word was weighted on cognitive anxiety or self-confidence. Substantial evidence has shown this inventory to be reliable and valid (Martens, Burton, Rivkin and Simon, 1981).

Dependent t-tests revealed significantly positive changes in self-confidence (p= .001; p= .002) and in cognitive anxiety (p= .02; p= .05) after meditation training for the meditation and combined groups respectively (see Appendix AH). Some of the comments reported by the soldiers in group two after meditation were: "I feel relaxed and clear headed", "It felt good and time went by very quickly", "With continuing sessions it becomes easier to relax and I am not so tired when the sessions are over". Comparable observations were noted by the combined group. Accordingly, meditation was found to be effective during training. However, the meditative training did not result in a statistically significant drop in perceived fatigue, exertion and heart rate in the second test situation.

Another related factor concerns the briefing of the mental training study by commanding officers and/or immediate supervisors to the soldiers. It appeared that soldiers were reluctant to participate in this aspect of the study because they were misinformed about what mental training involved. For instance, one soldier commented:

> "I was hoping it would be interesting but we were led to believe it was something different. If we had been told from the start it was dealing with sport psychology and relating that to the combat arms, the outlook for

more people would have been more positive." "We were told at the initial briefing that we were doing something different like a one-on-one basis" (see Appendix AE).

Later in the study, it was noted that not all subjects wanted to be part of this study. For some soldiers, the mental training phase was a way of getting an easy two-weeks with fewer duties. This was noticed when occasionally, a soldier arrived for a training session late or inebriated. It was also noticed on some questionnaires where the soldiers were asked if and when the mental training techniques were used. Two individuals in the biofeedback group and three in the meditation group preferred not to employ the designated strategies during the march. Ideally and realistically, if mental training was considered a privilege by the soldiers where they had to voluntarily apply and then be chosen through a selection process to take part in this type of training, the outcomes would be more trustworthy.

Another possible explanation for these inconsistent results might be the extremely large variability between subjects within a given group. This together with the small number of subjects per group resulted in large standard deviations and reduced statistical power. For instance, in Table 3a(i), standard deviations for fatigue levels varied from 103.17 to 166.78.

It should be noted that after mental training, 60% fewer soldiers dropped out of the second march before the end. In trial one, ten soldiers were unable to complete the march. Among them were six in the meditation group, three in the biofeedback group and one in the combined group. Following mental training, only four soldiers ended the march early. The subjects belonged to the biofeedback (2), control (1) and meditation (1) groups. The soldier in the meditation group had recently (four days prior) undergone medical treatment and felt a little weak. Though not statistically significant, the decrease in dropouts was considerable during the second march, particularly the meditation group. It must be noted that a potential learning effect may have been responsible for the improved compliance to the march since the soldiers were now familiarized with the marching task in the second trial.

Another possible explanation for nonsignificant results may have been that the meditation and combined groups were not sufficiently experienced in the meditation technique to apply it effectively thereby causing some feelings of frustration and helplessness. These feelings were expressed verbally by the soldiers while marching and in the mental training evaluation form (see Appendix AE). Twelve out of twenty-two recommended that more time (ranging from two weeks to six months) be spent on training meditation. It is interesting that Morgan et al. (1983) provided little or no training time for his subjects when they walked till exhaustion on the treadmill.

In Table 3a(ii), the control group significantly dropped in perceived fatigue. This may be rationalized on the basis that the majority of the group (8) went to Suffield, Alberta for some field training in artillery for two weeks. The mechanized and physical field training, under the project name "Rolling Thunder" consisted of mock artillery wars. The two week training program was described by soldiers as being particularly unpleasant because of adverse weather conditions. Returning to Currie barracks (PPCLI in Calgary) was a relief from the two weeks of training, according to several control group soldiers. It may be that the field training was so labor-intensive that it made the second weight-loaded march appear to be easier and less demanding than the initial march. Yet, only five soldiers were exposed to prolonged walking while wearing their fighting order during numerous infantry training drills (see Appendix AK).

It might also be that the two week experience of residing at the Suffield army base in tents were significant in a positive or negative manner. This experience might have preoccupied the control group soldiers' thoughts for most of the march.

Another possible explanation for insignificant scores in perceived fatigue and rate of perceived exertion might have been due to increased workloads for the treatment groups doing mental training. However, when the soldiers were asked if this speculation was true in a mental training evaluation form, nineteen out of twenty four soldiers confirmed that it was not the case (see Appendix AE).

Though potential discrepant scores of perceived exertion may have been assessed via self-reports from the Borg scale (1982), laboratory measures were introduced to verify individual's actual physiological exertion. Blood lactate measures were taken near the end of both marches (see Appendix AG). Blood lactate is a representative measure of physical muscular exertion during prolonged activity. It can assist to substantiate whether or not the actual physical exertion has changed for each individual (Astrand and Rodahl, 1977, p. 309). It also eliminates individual motivational discrepancies which may contaminate self-report measures. For instance, though most soldiers may perceive the march to be increasingly demanding, some may decide to "bite the bullet" and repeatedly state low rates of exertion like "6" (very light) while for others, their scores may be 14.

The treatment groups' blood lactate levels varied from $\underline{M}_1 = 1.60$ to 3.04 in trial 1 and from $\underline{M}_2 = 1.92$ to 2.85 in trial 2. The control group dropped slightly from $\underline{M}_1 = 2.90$ to $\underline{M}_2 = 2.00$. Following a two-way analysis of variance on levels of blood lactate levels during the march, no interaction effects were found [$\underline{F}$ (3,40) = 0.845, p=0.48)]. In summary, both blood lactates and reported rate of perceived exertion did not differ significantly from trial one to trial two.

In examining soldiers' estimates of time remaining in the march, no differences were found in the groups main effect and the group X trials interaction effect. Yet, a highly significant time main effect was observed. Subjects in all groups improved in predicting the approximate time remaining in the second weight-loaded march. Two alternate reasons for the improvement might have been that all soldiers decided to take the task at hand seriously or that soldiers had undergone a learning effect.

As stated earlier, Padgett and Hill's (1989) research identified altered estimates of time as subjects focused on external stimuli (a survey as subjects did stationary cycling). Similar findings were noted in hypothesis two, with individuals focusing on internal and external stimuli (away from the task at hand). Contrary to what was expected, all groups became more accurate, even the meditation and control groups.

The failure of the meditation treatment to alter time perception and reported fatigue in the hypothesized manner may have been influenced by the particular meditation task employed. Morgan et al. (1983) reported positive results when subjects were simply asked to focus on one word during the task. Very little training time was provided to apply the pseudo-mantra before the task. In the present study, 10 days were provided to learn the meditative technique. It might be that the effectiveness and success of Morgan et al.'s study resulted from a simple, easy to learn pseudo-mantra. In the present study, subjects were allowed to select their own mantra and imagery (according to criteria). By allowing this freedom, it might be that the imagery and mantra were too complex and thus required a much more controlled and quiet atmosphere for any benefits to occur.

Rejeski and Kenney, (1987) examined how simple mental dissociative tasks compared with complex dissociative mental tasks and found that subjects who preferred complex tasks performed better than control subjects when using complex and simple dissociative tasks. Yet those subjects who preferred simple tasks performed better only with simple dissociative tasks. Therefore, it might be that most soldiers in this study selected complex images when a simple image might have been more beneficial.

Though numerous alternate explanations exist, two of them appear to be crucial for future research. It would be interesting to identify subjects as either associators or dissociators before the actual physical task and then to selectively place them into appropriate mental training strategies (i.e., associators would train in biofeedback whereas dissociators would practise meditation). This procedure would lessen the possibility of subjects not using the technique taught.

Secondly, a larger sample size would have increased statistical power.

HEART RATE

Hypothesis 4a:

Subjects in the biofeedback and combined groups will maintain a lower heart rate (average difference in heart rate between trial 1 and trial 2) in the second march than will the meditation and control group.

Results:

The results pertinent to this hypothesis are summarized in Tables 4a(i) and 4a(ii). The descriptive statistics show that subjects across all groups combined evidenced lower heart rates on trial two (130.98) relative to trial one (138.78). The biofeedback and combined groups lowered their heart rate by 10 and 7.3 beats per minute while the meditation group decreased by 2.1 beats per minute. The control group experienced the greatest difference across the two trials with a decrease of 11.46 beats per minute.

TABLE 4a(i)

Descriptive Statistics For Four Treatment Groups On Self-Regulation of Heart Rate Across Two Trials During The March

	GROUPS	TRIAL 1		TRIAL 2		AVERAGE	
		M	(SD)	M	(SD)	M	(SD)
1	BIOFEEDBACK	137.70	15.59	127.70	12.83	132.70	14.21
2	MEDITATION	133.40	16.02	131.30	15.78	132.35	16.02
3	COMBINED	139.90	15.19	132.60	10.07	136.25	12.63
4	CONTROL	143.64	18.85	132.18	15.94	137.91	17.40
	AVERAGE	138.78		130.98			

TABLE 4a(ii)

Two-Way Analysis of Variance (Group X Trial) on Self-Regulation of Heart Rate During the March

Between Subject Factors (Groups)	Biofk	Medit.	Comb.	Control	
Within Subject Factors (Time)	Trial 1 Estimate		Trial 2 Estimate		
Source	Sum of Squares	DF	Mean Square	F Ratio	Prob.
Group	5514.98	3	1838.33	0.71	0.55
S-Within	98530.94	38	2592.92		
Trial	46908.14	1	46908.14	17.91	0.001 **
Group x Trial	6469.17	3	2156.39	0.82	0.49
B.S-Within	99526.06	38	2619.11		
Sig. Level * 0.05 ** 0.01					

The two-way ANOVA indicated a time main effect [F(1,37) = 12.00, p=0.001]; however, indicates the group X trial interaction effect was not significant. Therefore hypothesis 4a was rejected.

Hypothesis 4b:

Soldiers in the biofeedback and combined groups will be better able to self-regulate their heart rate during the second shooting test (i.e., lower their average heart rate on trial 2 in comparison to trial 1) than will the meditation and control group.

Results:

The results pertinent to this hypothesis are summarized in Table 4b(i) and 4b(ii). From trial one to trial two, heart rates generally went down except for the meditation group. While the biofeedback and control groups dropped by 6.63 and 6.44, the meditation group increased by 5.45 beats per minute. The control group, again, showed the greatest improvement, reducing their average heart rate by 12.75 beats per minute across the second trials.

TABLE 4b(i)

Descriptive Statistics For Four Treatment Groups On Self-Regulation of Heart Rate Across Two Trials Across The Shooting Trials

	GROUPS	TRIAL 1		TRIAL 2		AVERAGE	
		M	(SD)	M	(SD)	M	(SD)
1	BIOFEEDBACK	106.27	12.45	99.64	17.61	102.96	15.03
2	MEDITATION	100.44	5.94	105.89	5.21	103.17	5.58
3	COMBINED	114.22	6.08	107.78	9.18	111.00	7.63
4	CONTROL	115.13	12.86	102.38	10.49	108.75	11.68
	AVERAGE	108.70		103.73			

TABLE 4b(ii)

Two-Way Analysis of Variance (Group X Trial) on Self-Regulation of Heart Rate During the Shooting Test

Between Subject Factors (Groups)	Biofk	Medit.	Comb.	Control	
Within Subject Factors (Time)	Trial 1 Estimate		Trial 2 Estimate		
Source	Sum of Squares	DF	Mean Square	F Ratio	Prob.
Group	894.14	3	298.05	1.58	0.21
S-Within	6213.56	33	188.29		
Trial	474.17	1	474.17	8.54	0.006 **
Group x Trial	794.28	3	264.76	4.77	0.007 **
B.S-Within	1832.19	33	55.52		
Sig. Level * 0.05 ** 0.01					

The Analysis of Variance indicated a significant Group X Trials interaction effect [F(3,33) = 4.77, p=0.01]. A Tukey post hoc analysis revealed that only the control group had significantly dropped their heart rate at the 0.01 level of probability.

A time (trials) effects was also found F(1,33) = 8.54, p=0.01.

Discussion:

In examining the results from trial one and trial two, a general decrease was noticed. In Table 4a(i), the biofeedback and combined groups lowered their heart rates by 10 and 7.3 beats per minutes while the meditation group only changed by 2.1. In Table 4b(i), again the biofeedback and combined groups lowered their heart rates by 6.64 and 6.44 beats per minutes while the meditation group increased by 5.45. Although the results were not statistically significant, it should be noted that larger group samples may have evidenced the acceptability of the two previous hypotheses depending on the control group scores. Other studies have shown reduced heart rates during exercise with biofeedback (Jacob & Chesney, 1984).

It is possible that with more mental training both, biofeedback and combined groups might have better controlled their heart rate during the march.

Though both hypotheses are refuted, the control group findings of the previous two hypotheses correspond suitably with the results in Table 1b. In the second trial, the control group significantly dropped in perceived fatigue, reduced their heart rate the most during the march and significantly lowered their heart rate during the shooting compared to the three experimental groups.

One possible explanation might be that eight soldiers from the control group had gone to Suffield, Alberta to do artillery field training (see Appendix AK). The training pertaining to five control group soldiers in particular, involving a considerable amount of physical labor, may have improved soldiers' physical fitness and stamina specific to weight-load marching since they were expected to wear their fighting order throughout drill training.

It is common knowledge that increases in physical fitness improve the cardiovascular system and result in a lower heart rate (Keller and Seragania, 1984). Because of the cardiovascular improvement, their hearts performed the same work (march) with greater efficiency at a slower rate. As a result, the soldiers perceived less fatigue. As well, in consideration that the heart rate was lower during the march, a resting heart rate was recovered more quickly, i.e., in the shooting task.

SHOOTING PERFORMANCE

Hypothesis 5:

Subjects in the biofeedback and combined groups will improve more in the second trial shooting test than will the meditation and control group.

Results:

The results pertinent to this hypothesis are summarized in Table 5(i) and 5(ii). After measuring the sizes of the groupings composed of four rounds, it was found that the biofeedback and combined groups improved while the meditation and control groups became less accurate. The biofeedback group subjects shot marginally better from trial one (36.26 mm) to trial two (35.42 mm) while the combined group showed considerable changes from 33.10 mm to 25.46 mm in grouping size.

On the other hand, the meditation group became marginally less accurate with scores of 34.86 mm in trial one and 35.02 mm in trial two. The control group became even less accurate with an initial score of 31.51 mm and a final score of 36.02 mm.

A two-way ANOVA revealed a significant time X group interaction effect [F(3,40) = 4.35, p=0.01] Time main effects were not significant. A post hoc Tukey analysis showed a significant simple effect difference between cell means (T^1 v.s. T^2) for the combined group members at the 0.05 level of significance. In fact, their scores had improved in trial two by 23%. The three other groups did not significantly change from trial one to trial two.

TABLE 5(i)

Descriptive Statistics For Four Treatment Groups On Mean Shooting Performance During Two Trials Across The Shooting Trials

	GROUPS	TRIAL 1		TRIAL 2		AVERAGE	
		M	(SD)	M	(SD)	M	(SD)
1	BIOFEEDBACK	36.26	9.73	35.42	11.35	35.84	10.54
2	MEDITATION	34.86	6.34	35.02	12.49	34.94	9.42
3	COMBINED	33.10	5.44	25.46	5.02	29.28	5.23
4	CONTROL	31.51	9.49	36.02	10.90	33.76	10.20
	AVERAGE	33.93		32.98			

TABLE 5(ii)

Two-Way Analysis of Variance (Group X Trial) on Mean Shooting Performance During the Shooting Test

Between Subject Factors (Groups)	Biofk	Medit.	Comb.	Control	
Within Subject Factors (Time)	Trial 1 Grouping Size		Trial 2 Grouping Size		
Source	Sum of Squares	DF	Mean Square	F Ratio	Prob.
Group	558.59	3	186.20	1.34	0.28
S-Within	5556.38	40	138.91		
Trial	19.98	1	19.98	4.35	0.43
Group x Trial	416.54	3	138.85	4.35	0.01 **
B.S-Within	1276.13	40	31.90		
Sig. Level *0.05 ** 0.01					

Discussion:

The hypothesis was partially accepted since only the combined group improved significantly. It was expected that the combined group would perform better after having learned both, biofeedback and meditation techniques. It was also expected that the biofeedback group would improve more than the observed improvement. Daniels & Landers (1981) observed that shooters improved performance after having received biofeedback training primarily because of a better somatic awareness. Unlike this present study with soldiers, more personal trainer/athlete attention was provided to a group of individuals who were motivated and were eager to improve their competitive shooting scores. The soldiers' degree of commitment and eagerness to improve in mental training gradually waned in the final days of training.

A second difference between the Daniels and Landers' (1981) study and the present research was that their subjects did not undergo a sustained endurance march. Their subjects significantly improved with biofeedback under fully relaxed conditions.

Though the biofeedback group did not improve markedly, their comments in the post-march questionnaire suggest that the training was beneficial for them. "Good time and money well spent. It helped me greatly".; "I think the military should adopt this technique".

The meditation group became marginally yet not significantly less accurate in shooting performance from trial one to trial two. Similar results were presented in other studies when the effects of meditation on fine motor perceptual motor skills were examined (Wood, 1986; Williams and Herbert, 1976; and Williams and Vickerman, 1976).

For instance, Wood (1986) investigated the effects of meditation on fine (pursuit-rotor tracking) and gross (Luft cycle ergometer) motor performance. Though the size of the group samples were minimal (sixteen), no significant differences were found in performance of either fine or gross motor tasks. Williams and Herbert (1976) and Williams and Vickerman (1976) also studied Transcendental meditation and its effects on performance of fine perceptual-motor skills. Again no significant results were found.

A possible explanation for these results might be that meditation has been described and used as a cognitive dissociative strategy (Morgan et al., 1983). Therefore the technique would theoretically draw attentional focus away from a task as oppose to increasing attention toward a task. Accordingly, a cognitive associative strategy would theoretically improve fine motor tasks (i.e., biofeedback training).

Interestingly, though the control group did not change significantly, the average grouping size in the second trial was slightly bigger (i.e., a 7% drop in performance). This may have been attributed to the contrast between their Suffield training experience where they did live shooting drills with heavier types of artillary equipment (i.e., C-7, C-6 50 cal, M72 and 84 mm) and the present study where they shot with an FN C-1 set with a .22 LR insert at a short range.

In summary, the results did not show encouraging data toward the hypotheses with the exception of shooting accuracy. Yet when dealing more personally with the individuals, they commented very favorably toward the mental training program. The following section describes thei reactions to the Intervention.

SUBJECTS' REACTIONS TO THE INTERVENTION PROGRAMS

Information obtained from the self-report questionnaires, interviews and observations made during the treatment and testing sessions is presented below.

Although the treatment conditions did not result in statistically significant changes in the soldiers' perceived ability to do the weight-loaded marching task, a considerable number of Infantry soldiers commented favorably on the usefulness of the mental training strategies. Subjects rated the effectiveness of the mental training program very positively on a Likert-type scale ($^{-}5$ = not at all effective to $^{+}5$ = very effective). Table 6 describes the subjects' reactions to the intervention.

In general, mental training was perceived as being useful and helpful. The biofeedback group averaged a score of 2.49 (not including the "ability in detached observation" since this was pre-dominantly for the meditation group); the meditation group averaged 3.07 (not including the "ability to shoot accurately" since it was pre-dominantly for the biofeedback group) and the combined group scored an average of 3.14 out of a possible 5.

TABLE 6

Subjects' Reactions to the Intervention Programs

	Biofk MEAN	Med. MEAN	Com. MEAN
Your ability to relax	3.36	4.63	4.09
Rate the overall mental training technique	2.81	3.09	3.81
Your feelings of personal control	2.72	2.45	3.45
Your awareness of your body	2.72	2.27	3.54
Your ability to concentrate/focus	2.00	3.27	3.18
Your energy level	1.72	2.90	3.00
Your abilities to shooting accurately	2.09	___	2.45
Your abilities in detached observations	___	2.81	1.63

When asked "What helped the most?" some of the comments were as follows:

biofeedback group:

- "Temperature and heart rate control"; "Controlling my mind for heart rate as well as pain"; "It helped me put heat in my knee".

meditation group:

- "Being able to forget about pain"; "Thinking of other things"; "To relax".

combined group:

- "Focusing my mind on other things or nothing at will"; "Passing the time, switching off the feelings in my legs"; "The ability to relax myself during the march was easier this time".

Similar comments about the biofeedback and combined group training techniques were noted after the shooting.

biofeedback group:

- Just before shooting I "slowed my heart rate and relaxed" "... it helped me greatly"; "I thought about my breathing and heart rate"; "I tried to relax my forearm as much as possible".

combined group:

- Just before shooting I "just concentrated on my finger getting warm and it relaxed my body"; "calmed myself by breathing deeply";

One commonly perceived problem for having less than favorable quantitative results was time constraints. Although 1PPCLI cooperated well with the project leaders, time was a limiting factor. When asked if two weeks of training were sufficient, the biofeedback group suggested that one or two months would be required to go into more depth. The meditation group felt that a few more weeks would help reach greater benefits in meditation. Finally the combined group recommended that a range from 4 weeks to 6 months would be required to ensure an adequate level of competency. Furthermore when asked if they would have been willing to continue doing mental training for a longer period of time, the majority (28 out of 33 soldiers; 8 biofeedback, 9 meditation & 11 combined) of participants responded favorably.

One important factor was noticed during both, the testing trials and the mental training sessions. Some subjects were not very committed to the training procedures and therefore negatively affected the overall results concerning the effectiveness of the program. In retrospect, it appears that a few subjects may have volunteered for reasons other than wanting to learn a mental strategy. For instance, in the post-march questionnaire, five subjects reported not using the mental training during the march. During the actual mental training, six subjects missed a total of 18 thirty minute practice sessions. When some of these subjects did attend, they either arrived late, drunk or disturbed other participants.

In comparison, a total of 27 out of 33 soldiers were committed and a total of 16 thirty minute sessions were missed. When unable to attend practice sessions, soldiers informed the researcher and practised on their own time. Some biotic bands were provided to those in the biofeedback and combined groups. Committed soldiers were eager to learn and train (on time).

After sessions, motivated soldiers stayed and commented on the improvements they noticed since the beginning. Following the study, several soldiers requested further literature in the area of mental training. Casual observations indicated that the most motivated soldiers seemed to consist of higher ranking individuals (i.e. corporals, master-corporals and a sergeant) than the non-commited soldiers.

Following the two weeks of mental training, subjects were asked what they thought of the techniques. Their replies were generally very positive. For example, members from the biofeedback group commented:

> "I think that this is a very good method for the military and that everybody will benefit from it";
>
> "I found the mental phase to be very effective for me by finding out that my mind can control a lot of my body";
>
> "... this is beneficial on a larger scale than the physical training for soldiers to fight better, it's good"; "Very good idea, interesting";
>
> "Excellent, each soldier should be exposed to such training";

The meditation group generally suggested that the technique was useful yet more training was required in order to attain competency in it.

> "It helps"; "I think it will really help me";
>
> "I think that it was good training"; "It is good to know";
>
> "I think it is a good program and technique for some but not all";
>
> "It helped relax me but I don't feel it will help with the march and shooting";

Finally the combined group found the combination of biofeedback and meditation to be very valuable.

> "I think it is very interesting training";
>
> "I think that this program has helped to be more mentally fit and aware of what my body can and can't do";
>
> "It was worthwhile and would be more of an asset with more time";
>
> "The mental training had been well worth my time. I wish we had more

time to devote to it";

"I think it has helped me to relax and function better";

"That mental training is just as important as physical training";

"EXCELLENT! We need more training time";

"Keep training and looking at new approaches";

"I think it was very interesting and could be quite beneficial if used properly in the infantry".

It is speculated that if all soldiers had been commited to learning and using the mental strategies for personal and military use, the quantitative results would have differed from the present study. Unfortunately, because confidentiality was maintained in the mental training evaluation, it was not possible to limit the subject selection only to commited individuals.

In concluding, the results should be examined in light of the subjects' reactions to the training program, the time constraints and the limited sample size.

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

This study examined how sustained exercise endurance and shooting accuracy were influenced by two cognitive training strategies, associative (biofeedback) and dissociative (meditation) thinking. The study was based on a 4 (groups) X 2 (trials) factorial design where the performance of 40 Infantry soldiers were investigated during a sixteen kilometer weight-loaded march and in a riflery test.

In Trial one, soldiers from the Canadian Army performed the three hours of marching in a gymnasium and shot twenty five rounds in a miniature indoor shooting range. The march was executed in a gymnasium to control for environmental variables (e.g., rain, snow, wind, etc.) and the shooting was performed in a miniature indoor shooting range situated approximately 20 meters from the gymnasium. Both locations were appropriate for maintaining a respectable level of consistency in the two trials. Following the initial performance of the two tasks, subjects were randomly assigned to one of four groups: a biofeedback group, a meditation group, a combined biofeedback and meditation group and a control group following the tasks.

Trial two, identical to Trial one, was completed after two weeks of mental training. A two-way ANOVA with repeated measures showed that the combined biofeedback-meditation group was superior ($p=.01$) to the three other groups in the second trial of the prone shooting performance task. In fact, the combined group decreased their grouping size from 33.1 mm to 25.4 mm in trial two; a 23%

difference at a distance of 20 meters. The biofeedback and meditation groups changed minimally (2.2% and 0.5%). The control group, on the other hand, worsened by 12.5% thereby having larger grouping sizes.

In terms of marksmanship, this change could mean the difference between a pass or a failure. In more serious situations, it could mean the difference between life and death.

Significant improvement over the two trials was also observed in the soldiers' ability to estimate the amount of time remaining in the march and ability to lower heart rate levels while marching and shooting for all groups. Yet these improvements may not have been entirely due to mental training since their fitness levels may have changed as well (soldiers routinely do physical training every day). Infantry soldiers in the three experimental groups did not, however, significantly change across trials in their perceptions of fatigue levels and in rates of perceived exertion during the march.

In examining the participants' heart rates while marching and shooting, an overall drop was observed with the exception of the meditation group during the shooting test. Contrary to predictions, the control group was the only group to have a significant cardiac rate drop across the two shooting sessions. Yet, studies have shown that individuals can learn to significantly drop their heart rate with the assistance of biofeedback (Daniels & Landers, 1981; Bird, 1987). This discrepancy might be explained by the fact that Daniels and Landers (1981) examined elite shooting athletes who were genuinely eager and interested in improving performance whereas the soldiers in biofeedback and combined groups were not as motivated. The fact that the control group significantly reduced their heart rate in trial 2 might be explained by the Suffield training exercise for most of the control group. Though six of the eleven control group soldiers were assigned to sedentary tasks either in Suffield or in garrison (Calgary), five soldiers (riflemen) were actively training, by marching and doing drills with their fighting order on most of the time. This additional physical work may have resulting in a much better physical fitness level, hence lower heart rates.

While few significant changes (ability to better estimate the marching time remaining and lower marching heart rate) were detected, the soldiers generally commented that the techniques were useful and applicable in military settings (see Appendix AE). In many respects, if soldiers feel better after training because of their ability to relax, to control their tension, heart rate and temperature, the army unit wins in three ways. First, the soldier becomes multi-competent internally and externally. Secondly, soldiers may have a better attitude if they feel better and thirdly, the soldiers become aware of the army's concern for them as individuals and as soldiers since mental training skills are in fact life skills. This could assist the military in keeping quality personnel longer if "useful training for human care" (quote from a soldier) was provided (Appendix AE).

IMPLICATIONS AND RECOMMENDATIONS

In this new era of macro and micro-technology, the state of the art equipment today can become almost obsolete tomorrow. A great deal of time, effort and cost is invested in sophisticated multi-purpose equipment. Like the equipment in many respects, the infantry soldiers are trained to become fit, disciplined and multi-competent individuals who will know how to make designated equipment work up to its potential.

Interestingly enough, a great majority of military training emphasis seems to have been placed exclusively on external considerations. Little in the way of training, appears to have been devoted to the inner portion of the soldier, the mental part. Although this study provides little evidence for the value of mental training, these negative results might be attributable to methodological limitations in the field setting. Other evidence indicates that it is feasible in this day and age to train individuals to cope with boredom, perceived fatigue and pain. Also, it is possible for soldiers to quickly reduce their tension levels, lower their heart rates, increase their trigger finger temperature at will without moving (refer to Appendix AI). The potential benefits from this type of training are numerous.

For instance, mental training strategies can be useful for assisting rifle teams and snipers. The combined group in this study improved substantially in the span of two weeks without ever going to a shooting range. Rifle teams, snipers, biathletes, etc. could train conveniently and effectively on and off the shooting range. If a mental training routine was introduced or adopted as a daily task in Basic Training, convinced and committed soldiers and the army could possibly reap the benefits as was found by Larsson (1987) in the Swedish Forces.

Mental training may be the impetus required for the Airborne and the

Pathfinders to "reach down and give it their last 10%". In highly stressful jobs like the Search and Rescue Technicians (SAR TECs), soldiers can learn to control or cope with stress on long military exercises.

Biofeedback training can be very advantageous in the fall or winter time when the trigger finger is cold and the soldier is required not to move or when SAR TECs are required to treat casualties in cold weather. Noticeable temperature changes are possible in minutes when the soldier is properly trained (see Appendix AI).

Several concerns need to be addressed in future mental training research in order to lessen methodological limitations incurred in this study. First, there should be a clear understanding and military commitment with respect to the experimental subjects' schedules. Secondly, subjects should be required to apply to partake in a mental training exercise. In other words, the soldiers must want to learn. Thirdly, a larger sample size would strengthen the statistical results.

A wealth of possibilities exist yet as with the introduction of newer and better equipment, in order to keep the added edge in performance, soldiers need to be trained inwardly and outwardly.

Recommendations

When conducting research on an army base, unpredictable changes may occur. Although, few modifications were necessary for this study, it seems apparent that the results were adversely affected by the necessity of selectively assigning most of the control group because they had to train in Suffield for the next few weeks. Perhaps an earlier selection process of the subjects would have enabled military personnel or the investigator to reschedule or re-select randomly.

In future mental training studies, the commanding officer and/or immediate supervisors of the subjects should be briefed on the purpose, seriousness and benefits of mental training prior to the start of similar studies or training. The soldiers were informed at the initial briefing that they were undergoing some psychological testing, something different like a "one-on-one basis" (Appendix AE).

Also, not all subjects wanted to be part of this study. For some soldiers, the mental training phase was an easy way of having to do less work. Evidence of this was found in some of the soldiers' attitudes and in their answers in some self-report questionnaires. The effects of Mental Training would be more properly examined if soldiers saw the training as a privilege rather than a chore. For instance, if soldiers voluntarily apply and then were chosen through a selection process to take part in this type of training, the outcomes would be more trustworthy.

In the Subjective Appraisal of Cognitive Thoughts chart, a larger number of items might have assisted some soldiers to make a better judgement e.g., "I am presently thinking of nothing", "I'm hungry", "I'm tired and sore".

Ideally, a more suitable environment for mental training would have assisted in maximizing potential results. A proper relaxing atmosphere, conducive to learning would have been beneficial. The classrooms were cool and seemed to be misconstrued as being academic work for some soldiers.

The shooting platform was not sufficiently stable. The shakiness annoyed a considerable number of soldiers as they shot for accuracy. Especially since biofeedback was learned to minimize fine motor tremor by relaxing the muscles in the forearm supporting the rifle. This problem should be rectified in future shooting test. As a temporary measure, a jack was used to thwart the moving action of the platform.

In the present study there were many distractions while soldiers did the three hours of weight-loaded marching (i.e., talking between subjects, talking between soldiers watching and subjects, outside doors to the gymnasium were open to help regulate temperature, etc.). Future studies should lessen the number of distractions to identify whether or not associative or dissociative strategies are particularly effective.

In future mental training research, attempts should be made to use single subject experimental designs to better understand the individual and his/her cognitive strategies.

As well, some consideration should given to identify subjects as preferring either associative or dissociative strategies and to place them in groups with similar strategies. As with the present study and several others, this has not been taken this into consideration (Sacks, 1984; Weinberg et al., 1984; Masters & Lambert, 1989; Padgett & Hill, 1989).

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APPENDIX A

Subjective Appraisal of Cognitive Strategies

SINCE THE LAST CALL,

I HAVE THOUGHT MOSTLY ABOUT:

Associative Thinking	
A. How I feel physically.	e.g., I feel bushed.
B. How certain parts of my body feel.	e.g., my legs are a bit stiff.
C. Controlling parts of my body.	e.g., control my breathing.
H. Keeping the pace during the march.	e.g., watching the guy in front.
E. Specific layout of the gymnasium.	e.g., pylons are too far apart.
Dissociative Thinking	
D. Surrounding Conditions.	e.g., sound, temperature, light.
F. Past experience in the 2 X 10 march.	e.g., walked in mud; torture.
G. Thinking about personal matters.	e.g., think about home, vacation.
J. Talking to myself about others.	e.g., wife, friends, my dog.
K. Work, career and management.	e.g., promotions, my boss.

This chart was modified from Shomer's (1986; p. 139) version of cognitive strategies to make it more understandable for the infantry soldiers. A sample of ten soldiers was asked to scrutinize the chart so that it would be easily understood by all personnel.

Subjective Appraisal of Cognitive Strategies

A Feelings and affect

Thoughts concentrating on general sensations of the whole body, like feelings of vitality or fatigue, overall tiredness and stiffness without mention of specific body parts (e.g., I feel bushed; still feeling fine; no pain)

B Body monitoring

Thoughts of a here and now nature containing specific mention of anatomy, body parts, or body physiology like breathing rhythm, heart beat, or painful calf muscles (e.g., that lower leg seems a bit tight; shoulders feel a bit stiff).

C Command and instruction

Thoughts reflecting emphatic self-regulatory instructions to specific body parts or instructions to whole body functioning distinctly related to the activity and maintenance of running (e.g., relax my shoulders; breathe deeply now).

P Pace and monitoring

Verbalized feedback on current performance with respect to time, distance, speed or any other available form or method of pacing (e.g., about 30 minutes of marching to go; don't march too fast;)

E Environmental feedback

Thoughts of a here and now nature on the weather condition, temperature, light conditions, smell, and noise level (e.g., its warm in the gym; the air is hot and dry).

R Reflective activity thoughts

Thoughts on past and future issues related to marching, like past marching drill experiences, and future marching sites (e.g., I remember marching in the rain; Last year, I marched like this, ...)

S Personal problem solving

Thoughts revolving around issues of an intra-personal and interpersonal nature including reflective introspection belief system evaluation and modification (e.g., I wonder how my girl is?; as a kid I could never play in any kind of sport).

W Work, career and management

Thoughts spent on job, work and career opportunities including thoughts centering around the execution planning and construction of work (e.g., must get the kids to school on time tomorrow; I need to cut the lawn tomorrow).

I Course Information

Thoughts of a descriptive nature about scenery and general whereabouts that are of no consequences to pace (e.g., those walls look a little dirty; the pylons don't look evenly spaced).

T Talk and conversational chatter

Direct speech when in communication with other runners and thoughts expressing follow-up chatter to initial exchanges, as well as unintelligible or inconsequential extraneous chitchat (e.g., Hey, (name), how is your back?; that (name) can sure carry his load).

Found in Schomer (1986; p. 139).

APPENDIX B

Meditation Training Instructions

1. Sit quietly in a comfortable position.
2. Close your eyes.
3. Deeply relax all your muscles, beginning at your feet and slowly progressing up to your face. Find tense areas and deeply relax them.
4. Think of a relaxing scene where you would be resting comfortably. Once this scene is very visible in your mind's eye, identify colors, try to hear and feel it. Make it as real as possible.
5. In your imaginary scene, identify one relaxing word, (composed of one or two syllables; French or English), that you will use to focus on. (e.g., thinking of being in my backyard in a lawn chair; feeling a soft breeze, the smell of freshly-cut grass, and quietness around me. The word you choose will become your mode of transportation whenever you want to relax. In selecting your word, ensure that it contains no more than two syllables and that it is a relaxing-type word.
6. Breathe from the abdominal area and through your nose. Become aware of your breathing. As you breathe out, say your word "..." silently to yourself. (e.g., breathe in and out, "...", in and out, "..."; etc.)
7. Continue for about 20 minutes at which time I will remind you that there are 30 seconds remaining before opening your eyes.
8. Do not worry about whether or not you are successful in achieving a deep level of relaxation. Maintain a passive attitude and permit relaxation to occur at its own pace. When distracting thoughts occur, gently let the ideas flow away and return to your word "...". With practice, the response will come with little effort.

Modified version of Benson (1975, p. 114-115) and Everly and Rosenfeld, (1983, p. 98-99).

APPENDIX C

Consent Form and Analog for Dissociative Strategy

On your second march in about three weeks, we would like you to use a dissociative strategy that you will learn during the next two weeks. Many studies have shown positive results in using dissociative strategies for long distance activities. The intention of this study is to examine such a technique. Although there are many forms of dissociation, we would like you to employ the technique that will be introduced to you. During your second march, you will be asked the following: 1) Do not speak with fellow marchers during your march or shooting task. Not all participants in this study will be taught to dissociate, and therefore, we request that you do not discuss the technique with anyone, including the investigators and the technicians who will conduct the march and shooting task. Prepare yourself mentally for this march. 2) Concentrate on the technique throughout the march. 3) With every breath you take, exhale and repeat the "word" to yourself. Try to repeat it in a rhythmical fashion. Develop a rhythm and concentrate on it. The technique you will learn is believed to assist in not perceiving the same amount of fatigue, pain or discomfort that you experienced the first time you marched. However, you will actually be marching at the same speed on the second march as you did previously. Remember, we will want you to : 1) not speak to fellow marchers, and try to" psych" yourself up prior to the task; 2) concentrate on your word; and 3) say your word every time you exhale. Do you have any questions?

In concurrence with the Code of Ethics, confidentiality will be assured throughout the study.

I understand the nature and requirements of this experiment, and I volunteer to participate in the study.

Signature__________
Date __________

If the subject has any questions concerning this procedure, the investigator will answer them prior to starting the march.

by: Morgan, Horstman, Cymerman & Stokes,(1983, p. 258.)
(Analog was slightly modified to accommodate the present study).

APPENDIX D

Consent Form and Analog for the Biofeedback Strategy

On your second shooting task in about three week, we would like you to use the biofeedback strategy that you will learn. Elite rifle shooters have used the techniques and have found remarkable changes in their ability to shoot.

Although there are many forms of biofeedback, we would like you to employ the techniques that will be introduced to you. Please do so in the following way: 1) Do not speak with fellow marchers or shooters during your second march or shooting task. Not all participants in this study will be taught biofeedback, and therefore, we request that you do not discuss the technique with anyone, including the investigators and the technicians who will conduct the march and shooting task. Prior to the shooting task, prepare yourself mentally. 2) Concentrate on the technique throughout the shooting task. 3) Before every shot, remember the importance of your breathing, heart rate and tension. Try to prepare yourself to shoot as accurately as possible. The technique you will do is believed to assist in sharp shooting. You will be shooting the same number of rounds on the second trial as you did previously. Please take your time in shooting. Remember, we would like you to : 1) not speak to fellow marchers and shooters, and try to" psych" yourself up prior to the task; 2) concentrate on your biofeedback skills and 3) remember the importance of your breathing, heart rate and tension.
Do you have any questions?

In concurrence with the Code of Ethics, confidentiality will be assured throughout the study.

I understand the nature and requirements of this experiment, and I volunteer to participate in the study.

Signature_________
Date _________

If the subject has any questions concerning this procedure, the investigator will answer them prior to starting the march and/or shooting task.

APPENDIX E

Technical Check List for the Prone Shooting Position

Code Name: ____________________

	TRIAL 1			TRIAL 2			
	G	F	P	G	F	P	Comments
a) LOWER BODY							
1 left leg							
2 left foot							
3 right leg							
4 right foot							
5 right calf							
b) TRUNK							
6 angle with target							
7 hips							
8 left side of the body							
9 spine							
c) UPPER BODY							
10 shoulder line							
11 left arm angle							
12 left elbow							
13 left hand							
14 sling							
15 right shoulder							
16 buttplate-shoulder contact							
17 right elbow							
18 right wrist							
19 right hand							
20 trigger finger							
d) HEAD							
21 head position							
22 eye relief							
23 cheek pressure							
e) MECHANISMS							
24 natural alignment							
25 trigger pressure							
26 recoil, muzzle jump							
27 follow-through							
28 breathing							
f) MISCELLANEOUS							
29 height of the position							
30 general appearance							
31 regularity							

Biathlon Canada, (1988). Biathlon Level 2 Technical Manual, Ottawa Biathlon Canada, p. 6-25. G= Good; F= Fair; P= Poor

APPENDIX F

Schedule for the Treatment Groups

DAYS TIME	8:00	9:00	10:00	11:00	13:00	14:00	15:00
TESTING am, & pm.	Pre-t quest: Quest., MARCH, Heart rate, R.P.E., march to range; SHOOTING, shooting evaluation, post-tests, questionnaire, heart rate.						
	COMBINED		BIOFEEDBACK			MEDITATION	
1 Rm#1	EMG, 6s	EMG, 5s	EMG, 4s	EMG, 4s	EMG, 3s		
Room #2						MEDa 5s	MEDb 6s
2 #1	EMG,	EMG,	EMG,	EMG,	EMG,		
#2						MEDa	MEDb
3 #1	EMG,HR.a	EMG,HR.b	EMG, HR	EMG, HR	EMG, HR		
#2	MEDa	MEDb				MEDa	MEDb
4 #1	EMG, HR	EMG, HR	EMG, HR	EMG, HR	EMG, HR	COMa	COMb
#2	MEDa	MEDb				MEDa	MEDb
5 #1	HR,T,EMG	HR,T,EMG	HR,T,EMG	HR,T,EMG	HR,T,EMG	COMa	COMb
#2	MEDa	MEDb				MEDa	MEDb
6 #1	HR,TEM.a	HR,TEM.b	HR,TEM	HR,TEM	HR ,TEM	COMa	COMb
#2	MEDa	MEDb				MEDa	MEDb
7 #1	HR,T,EMG	HR,T,EMG	HR,T,EMG	HR,T,EMG	HR,T,EMG	COMa	COMb
#2	MEDa	MEDb				MEDa	MEDb
8 #1	HR,T,EMG	HR,T,EMG	HR,T,EMG	HR,T,EMG	HR,T,EMG	COMa ?	COMb ?
#2	MEDa ?	MEDb ?				MEDa ?	MEDb ?
9 #1	HR,T,EMG	HR,T,EMG	HR,T,EMG	HR,T,EMG	HR,T,EMG	COMa ?	COMb ?
#2	MEDa ?	MEDb ?				MEDa ?	MEDb ?
10 #1	HR,T,EMG	HR,T,EMG	HR,T,EMG	HR,T,EMG	HR,T,EMG	COMa	COMb
#2	MEDa	MEDb				MEDa	MEDb
TESTING am, & pm.	EMG = Electromyogram, T = Temperature regulation ? = questionnaire,				HR = Heart Rate MED = Meditation a & b = First & second group		

APPENDIX G

COMPETITIVE STATE ANXIETY INVENTORY - I

(Martens, Burton, Rivkin and Simon, 1981)

DISSOCIATION

Copyright was not obtained.

Description: The Competitive State Anxiety Inventory (CSAI) Form 1 is a short ten item self-report questionnaire. Items such as I feel "calm, nervous, secure, tense, etc." are measured on a five point Likert-type scale. Each word is weighted on cognitive anxiety or self-confidence. Substantial evidence has shown this inventory to be reliable and valid.

APPENDIX H

PRE-MARCH-1 QUESTIONNAIRE

Name: ________________ Date: _____

Height: _____ Age: _____

Weight: _____ Fitness Level: _____

Present Rank: ______________

Present Occupation: ______________

Number of years in the Military: ____

Number of years in the Army Infantry: ____

Circle the most appropriate answers.

When marching long distances in the military, do you think more about:

A	Feelings and affect	B	Body monitoring
C	Command and instruction	E	Environmental feedback
P	your pace and monitoring	R	Reflective activity thoughts
S	Personal problem solving	W	Work, career and management
I	Course Information	T	Talk and conversational chatter

When jogging long distances on your own, do you think more about:

A	Feelings and affect	B	Body monitoring
C	Command and instruction	E	Environmental feedback
P	your pace and monitoring	R	Reflective activity thoughts
S	Personal problem solving	W	Work, career and management
I	Course Information	T	Talk and conversational chatter

Do you run on a regular basis? _

If yes, how far do you run each week? __ to __ km/week

When doing weight-loaded marches in fighting order, do you feel any discomforts (e.g. blisters, sore back, etc.)? Explain.

____

____

How do you mentally cope with pain while walking? What do you think about?

____

____

When marching, how do you prevent or cope with boredom?

____

____

Use the reverse side of this page if more room is needed.

APPENDIX I

POST-MARCH-1 QUESTIONNAIRE

Perceived Fatigue and Symptoms

Circle a number on the scale where you feel that it represents your feeling most.

For the following, rate your feelings during the march and insert the number next to the descriptor. From #11 to #15, include additional feelings that you may have experienced during the march.

During the march, I experienced:

1/ sweaty hands 0......20......40......60......80......100

(not at all) (the worst ever)

2/ dizziness 0......20......40......60......80......100

(not at all) (the worst ever)

3/ shortness of breath 0......20......40......60......80......100

(not at all) (the worst ever)

4/ watering eyes 0......20......40......60......80......100

(not at all) (the worst ever)

5/ headache 0......20......40......60......80......100

(not at all) (the worst ever)

6/ stiff or sore muscles 0......20......40......60......80......100

(not at all) (the worst ever)

7/ flushed face 0......20......40......60......80......100

(not at all) (the worst ever)

8/ racing heart 0......20......40......60......80......100

(not at all) (the worst ever)

9/ upset stomach 0......20......40......60......80......100

(not at all) (the worst ever)

10/ congested nose 0......20......40......60......80......100

(not at all) (the worst ever)

11/ ______________ 0......20......40......60......80......100

(not at all) (the worst ever)

12/ ______________ 0......20......40......60......80......100

(not at all) (the worst ever)

13/ ______________ 0......20......40......60......80......100

(not at all) (the worst ever)

14/ ______________ 0......20......40......60......80......100

(not at all) (the worst ever)

15/ ______________ 0......20......40......60......80......100

(not at all) (the worst ever)

(Modified version of Pennebaker and Lightner, 1980, p. 167.)

APPENDIX J

POST-SHOOTING-1 QUESTIONNAIRE

Shooters' Awareness of Physiological Response Patterns (Daniels and Landers, 1982 p.167).

1. Are you aware of what is going on inside you physiologically while you are shooting? Explain.

2. Can you sense physical changes between a good shot and a bad shot? Explain.

3. Can you sense mental changes between a good shot and a bad shot? Explain.

4. When you are shooting poorly and you notice changes, are you able to return to the proper or comfortable state of mind you have while shooting well? Explain.

5. How consistent are your internal thoughts throughout the shooting cycle? Explain.

____

____

6. When shooting, do you know how fast your heart is going? Explain.

____

____

____

7. Do you know how long your breath hold is during each shot? Explain.

____

____

____

8. Are you left-handed or right-handed? ________

9. Do you aim with your left or right eye? ________

10. How frequently do you shoot per year? ________

11. How did you mentally prepare yourself before shooting?

____

____

____

____

____

12. What did you think about as you were shooting?

____

____

APPENDIX K

POST-MARCH-2 QUESTIONNAIRE

Perceived Fatigue and Symptoms

For all groups to answer. Please circle your answer.

In comparison to the first march, this march was

0......20......40......60......80......100

(easiest) (same) (the worst)

During this march, I felt 0......20......40......60......80......100

(not at all bored) (as bored as I have ever been)

Now, I feel 0......20......40......60......80......100

(not at all fatigued) (extremely fatigued)

During this march, I experienced:

0......20......40......60......80......100

(not at all) (the worst ever)

1/ sweaty hands ---------- 0......20......40......60......80......100

(not at all) (the worst ever)

2/ dizziness ------------ 0......20......40......60......80......100

(not at all) (the worst ever)

3/ shortness of breath --- 0......20......40......60......80......100

(not at all) (the worst ever)

4/ watering eyes -------- 0......20......40......60......80......100

(not at all) (the worst ever)

5/ headache ------------- 0......20......40......60......80......100

(not at all) (the worst ever)

6/ stiff or sore muscles - 0......20......40......60......80......100

(not at all) (the worst ever)

7/ flushed face --------- 0......20......40......60......80......100

(not at all) (the worst ever)

8/ racing heart ---------- 0......20......40......60......80......100
(not at all) (the worst ever)
9/ upset stomach --------- 0......20......40......60......80......100
(not at all) (the worst ever)
10/ congested nose -------- 0......20......40......60......80......100
(not at all) (the worst ever)
11/ foot blisters --------- 0......20......40......60......80......100
(not at all) (the worst ever)
12/ sore shoulders -------- 0......20......40......60......80......100
(not at all) (the worst ever)
13/ sore knees ------------ 0......20......40......60......80......100
(not at all) (the worst ever)
14/ sore shins ------------ 0......20......40......60......80......100
(not at all) (the worst ever)
15/ sore lower back ------- 0......20......40......60......80......100

16/ _______________ - 0......20......40......60......80......100

17/ _______________ - 0......20......40......60......80......100
(not at all) (the worst ever)
18/ _______________ - 0......20......40......60......80......100
(not at all) (the worst ever)
19/ _______________ - 0......20......40......60......80......100
(not at all) (the worst ever)
20/ _______________ - 0......20......40......60......80......100
(not at all) (the worst ever)

For Groups A, B and C only. Please circle your answer.

1. What percentage of the time did you use the mental training technique taught to you?

   0%.....20......40......60......80......100%
   (not at all) (all the time)

2. If the mental training technique was used, when was it used most? You may circle more than 1 number.

   0......20......40......60......80......100
   (beginning) (middle) (near the end)

3. If the technique was used, how effective was it for the march?

   0......20......40......60......80......100
   (not at all) (very effective)

4. Did it help to keep your mind away from pain during the march?

   0......20......40......60......80......100
   (not at all) (very much so)

5. Did it help to reduce boredom during the march?

   0......20......40......60......80......100
   (not at all) (very much so)

6. Were you more relaxed during the march?

   0......20......40......60......80......100
   (not at all) (very much so)

7. Did you feel a little more relaxed after this march compared to the first march?

   0......20......40......60......80......100
   (not at all) (very much so)

8. What helped you most in the mental training?

   ____

   ____

   ____

APPENDIX L

POST-SHOOTING-2 QUESTIONNAIRE

CODE NAME: ____________ DATE: May 14 or 15 am or pm

For all groups. Please circle your answer when appropriate.

1. How do you normally rank according to military standards in your Personal Weapons Test (C-7)? Marksman Pass Fail

2. Did you mentally prepare yourself before shooting? If yes, how?

____

____

3. When shooting, were you aware of:

your nervousness

not nervous 0......20......40......60......80......100
(not at all) (very much so)

your heart rate 0......20......40......60......80......100
(not at all) (very much so)

your breathing 0......20......40......60......80......100
(not at all) (very much so)

tension in your arms 0......20......40......60......80......100
(not at all) (very much so)

your finger temperature 0......20......40......60......80......100
(not at all) (very much so)

movement of the platform 0......20......40......60......80......100
(not at all) (very much so)

____________ 0......20......40......60......80......100
(not at all) (very much so)

____________ 0......20......40......60......80......100
(not at all) (very much so)

____________ 0......20......40......60......80......100
(not at all) (very much so)

4. Has the size of your grouping in this test improved compared to your normal grouping size? 0......20......40......60......80......100
(not at all) (very much so)

For Groups A, B and C only. Please circle your answer.

1. What percentage of the time did you use the mental training technique during the shooting task?
   0%.....20......40......60......80......100%
   (not at all) (all the time)

2. If the mental training technique was used for shooting, when did you begin to use it most?

a. - during the march 0......20......40......60......80......100
   (not at all) (very much)

b. - before shooting 0......20......40......60......80......100
   (not at all) (very much)

c. - during the shot 0......20......40......60......80......100
   (not at all) (very much)

3. Before the shooting task did you think the mental training technique would make a difference?
   0......20......40......60......80......100
   (no) (a bit) (moderately so) (yes)

4. Did your score improve from what you normally shoot as a grouping?
   0......20......40......60......80......100
   (not at all) (very much so)

5. If the technique was used, how effective was it for the shooting?
   0......20......40......60......80......100
   (not at all) (very effective)
   Comments:____
   ____

6. Are you normally nervous before or during shooting tasks? YES NO

7. Were you nervous before or during this shooting tasks? NO
   0......20......40......60......80......100
   (not at all) (very nervous)

8. Did you use the mental training technique? YES NO

9. If YES for both previous questions, did the technique help you to reduce

your nervousness before or during the shooting task?

0......20......40......60......80......100

(not at all) (very much so)

10. If the technique was used, were you more relaxed during the shooting?

0......20......40......60......80......100

(not at all) (very much so)

APPENDIX M

FORCES MOBILE COMMAND- PHYSICAL FITNESS STANDARDS

TESTING ADVISORY

TO: ALL PARTICIPANTS

Prior to your testing sessions, please note the following:

1. Do not smoke within four hours to start of a testing session.
2. Do not drink coffee or tea (or other beverage containing Caffeine) within four hours prior to your testing session.
3. Do not eat at least two hours prior to a test session. If you cannot avoid eating, eat lightly.
4. Do not consume any alcoholic beverages at least 24 h prior to a test session.
5. Do not exercise strenuously within 24 h prior your test session.
6. Do be on time for your test session, if possible, be early.
7. If you have any question(s) talk to one of the test coordinators.

APPENDIX N

HEALTH APPRAISAL QUESTIONNAIRE
(CF EXPRESS, 1989)

This questionnaire is a screening device to identify those members for whom physical activity might be inappropriate at the present time.

To the best of your knowledge:

	Yes	No
1. Do you have a restricted medical category which may prevent you from being evaluated or participating in a progressive training program?	☐	☐
2. Do you have any recurring problems with your back, shoulders, hips, knees or ankles which may prevent you from being evaluated or participating in a progressive training program?	☐	☐
3. Do you suffer from such things as: High blood pressure, heart disease, asthma, bronchitis, emphysema, diabetes, epilepsy, arthritis or cancer?	☐	☐
4. In addition to the above is there anything which you feel should be discussed with a medical officer prior to assessment?	☐	☐
5. Are you taking medication (prescribed or otherwise) which may affect your ability to undertake a physical evaluation?	☐	☐

6. How are you feeling today?

Excellent ☐ Good ☐ Physically tired ☐ Mentally tired ☐

Don't feel good at all ☐

Other (please specify) ☐ ____

APPENDIX O

B. THE CONSENT FORM FOR FIELD TESTS

I,____________ _____________authorize Dr. M. Singh and Roger Couture, the University of Alberta, and Major Wayne Lee of the Canadian Forces, to administer and conduct testing on field measures. These measures consist of weight-load marching for a distance of 16 km, and shooting accuracy. These tests are designed to monitor and record my physical abilities and attentional focus in performing army-related tasks. They will be conducted indoor to reduce uncontrollable variables for this study.

For safety purposes, during performance of field tasks if I experience intolerable discomfort, pain in the chest, shortness of breath, nausea, or dizziness, I will terminate the task without any explanation. The instructions will be given prior to the start of each task.

For marching, I will be required to do a 2 by 10 (miles) march at 120 paces per minute with full gear (24 kg). This pace is equivalent to marching speed of 5.5 km/h. The first march will be held between April 23 and April 29. The second march will be done May 14 or May 15. Following each march, I will go to the shooting range and shoot 25 rounds in a prone position.

Every effort will be made to conduct all the tasks in such a way as to minimize discomfort and risk. However, I understand that just as with other types of physical testing there are potential risks. These include episodes of transient light-headedness, fainting, chest discomfort, leg cramps and nausea and extremely rarely, heart attacks.

I acknowledge that the testing procedures have been fully explained to me and that I can withdraw my participation from the study at any time without prejudice. I hereby consent to participate on my own volition.

You are reminded that during the test procedures that you are on active military duty and are therefore entitled to all rights and considerations pertaining thereto.

DATE:______________

NAME:______________ (SIGNATURE) ______________

WITNESS:____________ (SIGNATURE) ______________

APPENDIX P

A. INSTRUCTIONS TO SUBJECTS FOR WEIGHT LOAD MARCH

The tester will read the following instructions to each subject prior to testing:

1. This task is a weight load march in full fighting order. It will be conducted at a set speed of 120 paces for a maximal distance of 16 km (10 miles) or until you can no longer continue. Each pace is 30 inches in distance. This pace is equivalent to marching speed of 5.46 km/h.

2. Your thinking patterns will be recorded every 13-14 laps on the call "Call SACS now". Your rate of perceived exertion and perceived time remaining will be recorded for every fifteenth lap. Upon command "Call Your Perceived Exertion and time remaining Now" you will read out the exertion score while marching in front of the recorder's table. You must maintain the pace until the distance is completed or exhaustion is reached.

3. You will be provided 15 minutes of time for a general warm-up before the start of the test.

4. Verbal encouragement will not be given to help motivate you.

5. Should you not be able to maintain the pace, move to the inside of the gymnasium and your test will be stopped.

6. Once the test has ended, you shall walk downstairs to the shooting range located under the gymnasium. You will be asked to answer 2 short questionnaires and you will be asked to shoot 25 rounds of .22 calibre rifle (5 rounds for practice) in a prone position. Two short questionnaires will be answered after the shooting. Then, you will continue to walk upstairs to the downloading site. You must stay in the test area until your heart rate has dropped below 100 beats per minute. Do not leave until the tester is confident that you are fully recovered. Medical assistance will be available in the gymnasium at any time.

7. If you feel this test is too demanding, you may stop at any time without any explanation.

8. Are there any questions?

APPENDIX Q

B. RECORDING FORM FOR RATE OF PERCEIVED EXERTION DURING WEIGHT-LOAD MARCHING

TRIAL 1 TRIAL 2
Date: __________ Date: __________

Group: ___

Code Name:____________

LAP	RPE	COG	RTI	PTI	DIFF	RPE	COG	RTI	PTI	DIFF
15										
30										
45										
60										
75										
90										
105										
120										
135										
150										
165										
TOTAL										

APPENDIX R

The Rate of Perceived Exertion Scale (RPE)

Borg (1982)

Copyright was not obtained.

Description: The RPE scale is a 15-point instrument ranging from 6 to 20. The instrument has several identifiers at every uneven number (e.g., 7 "very very light" and 19 "very very heavy"). It has been found to correlate linearly with heart rate (Pollock, 1989). In fact, the original concept of the RPE was developed with heart rate in mind. For instance, Borg's scale relates 6 to a resting heart rate of 60. A value of 9 would relate to a heart rate of 90 beats per minute.

APPENDIX S

LIST OF GROUPS

A	B	C	D
A1	B1	C1	D1
1.__________	1__________	1__________	1__________
2.__________	2__________	2__________	2__________
3.__________	3__________	3__________	3__________
4.____[illegible]	[illegible]__________	4__________	4__________
A2	5__________	5__________	5__________
5.__________	B2	C2	6__________
6.__________	6__________	6__________	7__________
7.__________	7__________	7__________	8__________
8.__________	8__________	8__________	9__________
A3	9__________	9__________	10__________
9.__________	10__________	10__________	11__________
10.__________	11__________	11__________	
11.__________			

APPENDIX T

Schedule for the Treatment Groups

TIME	8:00	9:00	10:00	11:00	13:00	14:00	15:00
DAYS	C		A			B	
30 Rm#1 Mon	C1 5	C2 6	A1 3	A2 3	A3 4	B1 5	B2 6
Rm#2							
1 #1 Tue	C1	C2	A1	A2	A3	B1	B2
#2							
2 #1 Wed	C1	C2	A1	A2	A3	B1	B2
#2	B1	B2					
3 #1 Thu	C1	C2	A1	A2	A3	B1	B2
#2	B1	B2				C1	C2
4 #1 Fri	C1	C2	A1	A2	A3	B1	B2
#2	B1	B2				C1	C2
7 #1 Mon	C1	C2	A1	A2	A3	B1	B2
#2	B1	B2				C1	C2
8 #1 Tue	C1	C2	A1	A2	A3	B1	B2
#2	B1	B2				C1	C2
9 #1 Wed	C1	C2	A1	A2	A3	B1	B2
#2	B1	B2				C1	C2
10 #1 Thu	C1	C2	A1	A2	A3	B1	B2
#2	B1	B2				C1	C2
11 #1 Fri	C1	C2	A1	A2	A3	B1	B2
#2	B1	B2				C1	C2
TRIAL 2	May 14 and May 15 Groups A, B, C, and D will be tested.						

Appendix U
The Use of Biotic Bands II

Each Biotic Band consists of two columns of temperatures (78°F to 94°F and 80°F to 96°F). Next to each number is a rectangular patch of liquid crystals which remains black until a temperature is within two degrees of the designated temperature number. For example, when the temperature is 78°F the patch next to 78°F on the band will light up and a red-tan color will be noticed. Subsequently, with every change of 0.5°F, the color will change to orange, yellow-green, blue-green, and finally blue. When the temperature is 80°F the patch next to 78°F will show blue and the patch next to 80°F will show a red-tan color. The same sequence is repeated throughout all temperature. The Biotic Band can be used on any finger according to the following instructions:

1 Wrap the Biotic band around a finger so that the numbers are on the pad of the finger and the velcro is on the nail side.

2 The top of the band should be about 1 cm below the tip of the finger and the bottom of the band should be toward the base of the finger.

3 The band should not be wrapped either too tightly or too loosely; if it is too tight, it will interfere with free flow of blood, and if it is too loose, it will not make proper contact for correct temperature measurement.

4 When taking a reading, always read the highest temperature showing regardless of how many patches are lit up.

5 Always ignore the purple color which may sometimes be visible on some squares.

Degrees	Red-tan	Orange	Yellow-gr	Blue-green	Blue
78oF	78oF	78.5oF	79oF	79.5oF	80oF
80oF	80oF	80.5oF	81oF	81.5oF	82oF
82oF	82oF	82.5oF	83oF	83.5oF	84oF
84oF	84oF	84.5oF	85oF	85.5oF	86oF
86oF	86oF	86.5oF	87oF	87.5oF	88oF
88oF	88oF	88.5oF	89oF	89.5oF	90oF
90oF	90oF	90.5oF	91oF	91.5oF	92oF
92oF	92oF	92.5oF	93oF	93.5oF	94oF
94oF	94oF	94.5oF	95oF	95.5oF	96oF
96oF	96oF	96.5oF	97oF	97.5oF	98oF

Khemka; Bio-Temp Products Inc.

APPENDIX V

HEART RATE TRAINING CHART

DAYS OF TRAINING

Beats/Min.	1	2	3	4	5	6	7	9	10	11	12	13	14	15
90														
89														
88														
87														
86														
85														
84														
83														
82														
81														
80														
79														
78														
77														
76														
75														
74														
73														
72														
71														
70														
69														
68														
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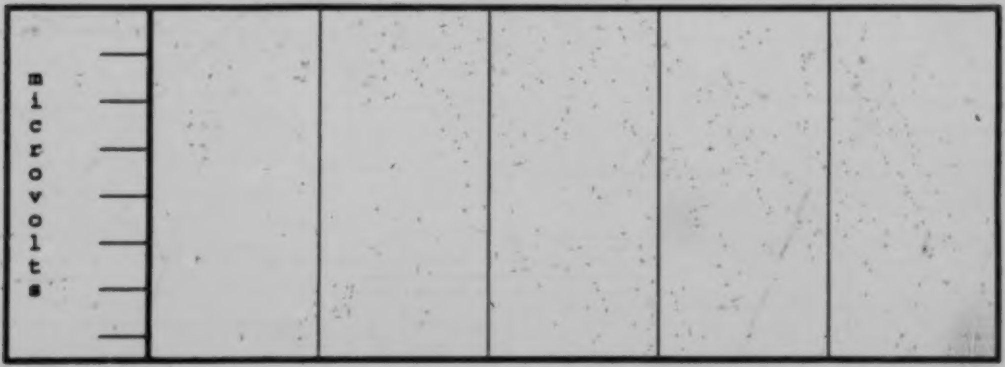
56														
55														
54														
53														
52														
51														
50														
49														
48														
47														
46														
45														

Date: ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___

Based on the P.E. 3000 Sport Tester with visual and auditory feedback every 5 seconds.

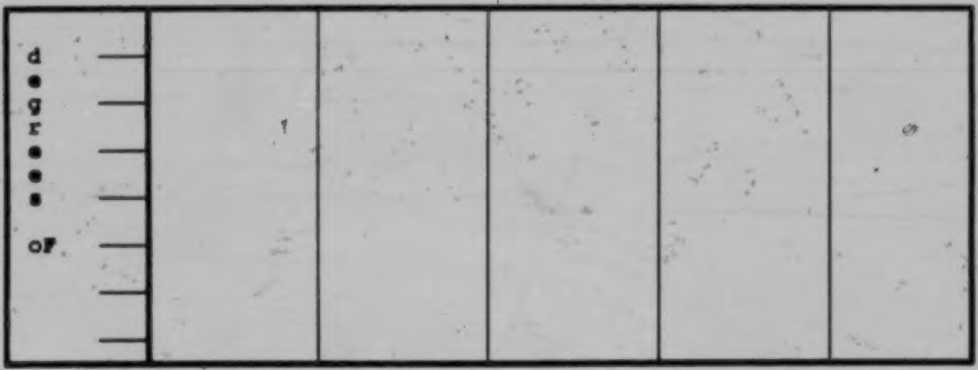
APPENDIX W

EMG TRAINING CHART



Date: ________ ________ ________ ________ ________
Time Period: ________ ________ ________ ________ ________
Muscle(s): ________ ________ ________ ________ ________
Feedback: ________ ________ ________ ________ ________

SKIN TEMPERATURE TRAINING CHART



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APPENDIX X

Rifle 5.56 mm. C7 (DND, 1987)

The C7 is the principal small arms weapon for the Canadian Force. It is used in a variety of situations ranging from conflicts of nuclear war to peacekeeping and internal security. The rifle resembles the American M16 A1E1 made by Colt Firearms. The Canadian-made weapon (Diemaco Company, Kitchner, Ontario) was the result of the "most extensive small arms trials and tests ever conducted in Canada". A number of modification from the original M16 make the C7 uniquely Canadian.

The technical specifications of the C7 rifle consist of the following (DND, 1987, 1-3):

1. Calibre 5.56 X 45 mm NATO
2. Weight
    - Rifle 3.34 kg
    - Loaded 3.89 kg
3. Length
    - Rifle 1.0 m
    - Barrel 0.53 m
    - Sight Radius 0.50 m
4. Rifling 6 grooves, right hand, 1 turn in 178 mm
5. Cyclic Rate of Fire 700 to 940 rounds per minute
6. Modes of Fire repetition and automatic

7. Operation gas operated, air cooled, magazine-fed

8. Sights small aperture for deliberate 200 to 300 m

Includes a large aperture for Close Quarter Battle and low light 0-200 m

9. Effective Range 400 m

10. Magazine 30 rounds

The C7 can be fitted with a bayonet for close quarter fighting. Included within the butt is a full cleaning kit consisting of:

1. The protective case
2. A four-piece rod
3. A swab holder
4. A bore brush
5. A chamber brush
6. A bolt key brush
7. A container of Cleaner, Lubricant, Preservative (CPL)
8. Pipe cleaners
9. Swabs (25 mm by 25 mm)

Appendix Y

Rifle, 7.62 mm, FN, C1A1 (DND, 1982)

The FN, made in Belgium, was designed and used as the infantry's personal weapon for the Canadian Forces until 1987-88 (Ebbet, 1990). This weapon is air-cooled and gas operated. As with the C7, it is magazine fed and self-loading yet unlike the C7, it fires 7.62 mm, capable of only 20 round magazines and is semiautomatic only. The technical specifications of the FN are the following:

Main Equipment	- weight (normal butt)	4.26 kg
	(full magazine)	4.97 kg
	- length (normal butt)	1.15 m
Barrel	- length	53.4 cm
Number of grooves		6
Pitch		1 turn in 30.5 cm
Butt lengths	Extra long	29.2 cm
	Long	27.9 cm
	Normal	26.0 cm
	Short	24.8 cm
Sighting data	Rear sight	aperture
	Front sight	blade
	Sight radius	53.84 cm

It is fitted with a folding disk sight with aperture increments from 180 to 550 m. The FN can serve a variety of purposes with ancillary equipment such as a bayonet, a blank firing attachment and a grenade launcher. Moreover, it can be modified with a sub-calibre conversion kit. This feature enables soldiers to practice during inclement weather in a miniature indoor range and also minimizes the cost of shooting.

Appendix Z

Adapter, sub-calibre, 7.62 mm, C1A1 (DND, 1984)

This adapter sub-calibre conversion kit, manufactured by Heckler Und Koch, enables up to 20 rounds of .22-inch calibre LR rounds to be fired from one magazine once installed in a standard 7.62 mm FN (DND, 1984). The adapter kit consists of the five following items:

a one-barrel tube assembly.		136 gm
a one-breech mechanism assembly.		369 gm
a magazine,	empty	617 gm
	full	738 gm
one storage case	empty	1419 gm
	full	3490 gm

In total, an additional 505 gms was added to the FN during the shooting exercise. In order to properly install the Sub-calibre adapter kit, the following steps were taken (DND, 1984, 3-1):

1. Remove the 7.62 mm magazine
2. Cock the weapon and move the change lever to the "SAFE" position.
3. Remove the 7.62 mm breech block and carrier, and the body cover.
4. Insert the 0.22-inch calibre barrel tube assembly into the rifle.
5. Insert the breech mechanism assembly into the body ensuring that the mechanism is correctly positioned in the guideway and the the adapter block bears evenly against the rear face of the barrel tube sleeve.
6. Replace the body cover and close the weapon.
7. Pull the trigger to release the hammer.
8. Insert the 0.22-inch calibre adapter kit magazine.

Once the conversion kit is completely installed, the FN C1 becomes an acceptable firearm for miniature indoor shooting ranges.

Appendix AA

Ammunition

A number of rifle ammunition is available for the infantry's personal weapon, the C7. Although cartridges differ in functions, they rarely vary in sizes. Before the C7 appeared, the NATO approved standard bullet was 7.62 mm. Since the C7, cartridges are now 5.56 mm thereby easing soldiers' carrying load. Each of the six types are specially designed to perform the following tasks (DND, 1983):

Ball - Used against humans, they are capable of inflicting fatal wounds up to 2 km away and up to 800 m against soldiers wearing steel helmets or armored vests.

Tracer - Used to show the location of targets, it leaves a phosphorescent trace capable of being seen at 115 m yet nearly invisible for the first 14 m. It has a minimum range of 800 m.

AP - Used against unarmored vehicles, it is capable of penetrating mild steel and causing fatal wounds to soldiers inside from 600 m.

Incidiary - Capable of igniting flammable material up to 1800 m away.

API - Capable of piercing fuel tanks and lighting the fuel of lightly armored vehicles from 400 m away.

Observing - Used to indicate the location of the target and exhibits visible puffs of smoke upon contact.

Dummy rounds - Used primarily for shooting drills and for indoor ranges, the bullet is not equipped with a cap "or a propellant charge".

Blank rounds - Used for training, the cartridge contains no projectile. The debris, however can be dangerous up to 20 m.

Appendix AB

Miniature Indoor Range

Military ranges vary according to specific needs and allocated space. For instance, the Department of National Defence identifies the five types of shooting ranges (DND, 1981; 13-47):

Type IA standard indoor range

Type IIRange in drill hall; gymnasium or any suitable building

Type IIIOutdoor range with a danger area

Type IVOutdoor range with full stop butt, without a danger area

Type VPartially enclosed range without a danger area.

In this present study, the Harvey Hall Range was used. It is a type II miniature indoor range with a firing point of 20 yards (DND, 1981, 14-18). Although the firing point is a two-tier platform construction, capable of holding eight prone shooters, only four subjects were allowed at any one time, to ensure a higher level of safety. Behind the firing point there was a table (95 cm X 210 cm) and four chairs, a stretcher and a first aid kit. During live firing, a large ventilating fan was in operation to minimize the amount of potentially hazardous fumes and lead contamination.

Indoor ranges may pose serious threats to members because of the lead residue. In fact, extended exposure to lead without precautions may result in lead poisoning. Along with proper ventilation, the following points were respected:

a/Dry sweeping of the indoor range (to gather empty casings) is prohibited.

b/A damp mop or a properly filtered vacuum may be used to clean a range.

c/Workers cleaning or maintaining the range will wear protective clothing and respiratory protection.

d/Eating and drinking are forbidden in the range.

e/Personnel working in the range will wash their hands immediately after leaving (DND, 1988, 14-13).

The target holders consisted of four large thick pieces of bristle board (125 cm X 95 cm; white). The targets were pinned onto the bristle boards at a height of 150 cm from the floor. Behind the target holders was a bullet catcher. It consisted of a large concrete slab set at 45°. Directly below the slab was a large sand box to absorb and accumulate the lead projectiles. To protect shooters from potentially stray projectiles, the shooting range was equipped with baffles, suspended from the ceiling. These baffles consisted of a 3 cm boarding on a appropriate framing reinforced with 3 mm of steel plates. They extended to both sides of the range and were about 25 cm in width (DND, 1981, 13-54). Although a miniature indoor range is very well suited for shooting practice, safety with weapons should be of utmost importance.

Appendix AC

Range Safety Officers

The Military has very stringent rules for the operation of shooting ranges. Whenever a shooting practice is held, the individual in charge must ensure that all members abide by the instructions found in the "RANGE STANDING ORDERS". The Range Safety Officer (RSO) normally an officer, Warrant Officer or senior Non Commissioned Officer (NCO) is given full responsibility to conduct live firing on a range (DND, 1981). It was the intention of the researcher to have one RSO available to supervise and control both trials of the study. However, due to unforeseen circumstances, two RSOs were provided; Master-Corporal R. Pickell and Sergeant D. Morris.

For trial one, Master-Corporal R. Pickell (24 years old with 5 years of Military experience). His qualifications are the following:

- A Machine Gun Course (6 weeks)
- Ranked as a "Marksman" according to the Personal Weapons Test.
- He shoots between 80 and 100 rounds once per month.
- He had seven years of shooting experience prior to military training.

For trial two, Sergeant D. Morris (27 years old with 10 years of military service) acted as the RSO for two days (May 14 - 15). His qualifications are the following:

- Certified as a Small Arms Instructor (10 weeks)
- Certified Coach for Small Arms (2 weeks)

- He has trained basic infantry troops in Battle School.

- He has been responsible for ranges for 8 years.

- He had three years of shooting experience prior to joining the military.

Appendix AD

Target Scoring

A number of target scoring techniques exist. While some targets offer calibrated circles of varying size, others have circles without the scores. The latter targets were utilized in this study primarily because there was no time for each soldier to zero the rifles before shooting. Accordingly, grouping scores are generally the only acceptable way of scoring shooting performance without zeroing.

Two ways of scoring targets are outlined in the "Shoot To Live" program. For instance, a rectangle is drawn by connecting the outer edges of all shot holes. This is known as the "Actuality Group". It indicates the shooter's actual ability at the present time (DND, 1983a, 3-22). A smaller rectangle contains the four closest shots which are known as the "Capability Group". This grouping indicates the shooter's potential capability. For the capability grouping, the sides of the drawn rectangle are square to the sides of the target. From the capability grouping, two diagonal lines go from corner to corner of the rectangle. The middle of the grouping or mean point of impact (MPI) is where these diagonal lines intersect. A transparent template of the target scores is then superimposed over the grouping. The center of the template is pinned to the MPI. This method is preferable for five-round groups when zeroing and dealing with 5.56 mm cartridges and at distances of 100 m or more (Morris, 1990; DND, 1983a).

A second technique suggested by the Shoot To Live program is to only consider four shots thereby eliminating a stray bullet shot. In this manner, the subject is given "full benefit" of a Capacity Group. Two perpendicular lines of the capacity group are extended to the edges of the target. This then determines the smallest Actuality group. A word of caution is noted; three or less bullet holes are insufficient to draw a square-sided grouping, essential for identifying the MPI for sight correction (DND, 1983a).

The "Shoot To Live" program notes that "a 'wild' shot in an otherwise adequate grouping should not be included in the grouping score (National Defence, 1983a, 3-36). In compliance with the program, this study delimited the grouping to only four shots per target. The farthest bullet holes from each other on one target are measured in millimeters from center to center of the perforated holes (Morris, 1990). Subsequently, the grouping sizes of all four targets were totalled and averaged. The average grouping constituted the individual's score. This technique for measuring grouping sizes was performed by only one person to ensure consistency in scores.

APPENDIX AE

MENTAL TRAINING EVALUATION

Held April 30 - May 11, Currie Barricks, 1 PPCLI

1/ According to you, was the time allowed (two weeks) appropriate for this type of mental training? Yes No.

If No, what would you recommend?

---

5 Yes; 6 No

1 month to perfect the technique A;

2 months A; more in depth A;

You need more time so these tests are more effective A;

I think the training should be longer and given to all personnel A;

---

8 Yes; 3 No

To be effective in this type of training it would take years to achieve superconsciousness B;

It was only one hour per day and too many distractions during the rest of the day B;

At least 2 more weeks B;

---

2 Yes; 9 No

I would recommend about 6 months which I think would bring more accurate results C;

I recommend more time a couple of months if possible and a few classes now and then to keep the practice C;

Two more weeks would allow an individual more experience C;

More time spent on each man to help him or her through difficulty with training i.e.. mental focus C;.

(2) 4 weeks minimum to see your potential C;

It should be lengthened, more time should be allotted C;

2/ Would you have been willing to continue doing mental training for a longer period of time? Why or why not?

---

8 Yes; 2 No

Yes if I was or had time to apply it while I was doing it e.g., more range work, shooting A;

Yes because it was helping me with my work habits as well as personnel life A;

(2) Yes because the longer the time period, the more control I could have obtained with my body i.e., heart rate, muscle control A;

Yes just learning more about the body helps A;

No because it has nothing to do with how you shoot or physical fitness A;

(2) Maybe, if it became more interesting, but it was getting boring A;

(2) Yes I was beginning to enjoy the training very much A;

Yes because it is beneficial on city streets as well and the longer it's done the more thorough you could be A;

---

9 Yes; 2 No

Yes learn more control B; Yes, it was helping and I enjoyed it B;

Yes because I felt it was good training and fits into our jobs B;

Yes to see if I could hit all the stages (of meditation) B;

Yes because it relaxed me before work and helped clear my head B;

Yes because it could only help B;

No towards the end it was monotonous B;

No it becomes too frustrating to me; the more I do it the more I dislike it B;

Yes because relaxation and mental training are essential for stress control and life in general B;

Yes to better mental awareness B;

---

11 Yes;

Yes, I find it very interesting and would like to learn more about other parts of my body C;

Yes because it shows what you can do with your body by concentrating C;

Yes I'd like to but with different observations because if you spend too long on the same observations you can get really bored C;

Yes because I think it would be to my benefit to be more in control of my mental state C;

Yes because I feel it is useful and can improve your physical and mental standing C;

Yes, I feel that I really benefited from the mental training C;

Yes I feel we were just starting to get used to controlling our bodies and would have liked to see how far I could go C;

Yes because we are just beginning to understand what and how we are suppose to concentrate C;

Yes to give me a fuller understanding of myself and of my personal capabilities C;

Yes it (body control) can only get better C;

Yes it would allow me to get better at it and also show the effectiveness it would have on my ability in relation to a soldier C;

3/ When you first heard about the mental training phase what did you think?

I thought to myself I hope it's not me A;

Stupid idea; waste of time and money A;

I thought it didn't have much to do with first three parts as far as the P.T. testing goes A;
I thought it would be interesting to learn to control specific parts of the body and what happens to them A;
I was negative A;
I thought it was something totally different A;
I thought back in grade 10 in High School A;
Would it help?
I didn't know what to expect at first, whether I was going to be surrounded by a bunch of doctors A;
I thought that it would be more of questions and answers rather than heart rate, EMG and skin temperature A;
I heard it was possible but was not sure I could get into it A;

That it would do nothing B;
Skeptical B; Nothing B; Nothing in particular but was willing to try it B;
I thought it was useless B; Ha, Ha, Ha B;
I thought it was going to be a bunch of mental games and questions B;
It would be boring B; To be able to control your thinking B;
I thought it would be a lot of mental testing B;
I don't remember B;

I was hoping it would be interesting but we were lead to believe it was something different. If we had been told from the start it was dealing with sport psychology and relating that to the combat arms the outlook for more people would have been more positive. Were told at the initial briefing that we were doing something different like a one on one basis C;
Good, it's about time C;
Extremely interested. I went out of my way to get in this phase C;

Shrink! Head games! Lies! C; I didn't think it would benefit me C;
I thought that it would probably be a waste of my time C;
I was unsure as to what we would be doing C;
At first I didn't want to be a part of it but after doing it I think that it could have very positive results for me C;
I didn't know what we were going to do but when I found out what was going to take place I found it really exciting C;
I thought it would be a good thing to try and see what I could do C; I thought it would be all head games C;

4/ What do you think now?
Yes it is possible A; I think that this is a very good method for the military and that everybody will benefit from it A;
I found the mental phase to be very effective for me by finding out that my mind can control a lot of my body A;
It did help to control my breathing A;
The same thing A; Some parts were a little helpful A; Its good training A; I do not have the control (i.e., temperature) that I thought I would have after 2 weeks A;
The same except this is beneficial on a larger scale than the physical training for soldiers to fight better, it's good A;
Very good idea, interesting A; Excellent, each soldier should be exposed to such training A;

It could work if properly implemented but I can't see how you would do this on the march B; It helps B; I think it will really help me B;
I think that it was good training B; It is good to know B;
I think it is a good program and technique for some but not all B;
I think the right technique could help B;
It helped relax me but I don't feel it will help with the march and

shooting B;

It went on too long for me B; It has potential with continued training and awareness to be a great help B; That it made me mentally sounder B;

I think it is very interesting training C; Trying to relax C;

I think that this program has helped to be more mentally fit and aware of what my body can and can't do C;

It was worthwhile and would be more of an asset with more time C;

The mental training had been well worth my time. I wish we had more time to devote to it C;

I think it has helped me to relax and function better C;

That mental training is just as important as physical training C;

EXCELLENT! We need more training time C; Keep training and looking at new approaches C; I think it was very interesting and could be quite beneficial if used properly in the infantry C;

5/ What part of the training program helped the least (if any)?

---

(4) I feel that all aspects were of significant value A;

(4) Temperature (couldn't quite get it to work) A;

Reducing heart rate A;

EMG A; To relax your muscles A;

---

(6) Nothing B;

Sitting for an hour each day B;

Having to focus on a certain picture and bring movement, sound and color into it B;

They all helped. One weak one due to more time needed in my case was heart rate control and shooting after a run C;

(3) Nothing they all helped me C;

(4) The heating of the finger C;

The relaxing of the muscles I didn't feel that it had a noticeable effect on my performance C;

I'm not too strong with meditating, especially the last couple of days, I had a lot of distracting thoughts. The first couple of days I got right into it though C;

6/ Would you recommend that the military	A	B	C
a) begin this type of mental training on a regular basis?	3	4	8
b) perform this technique with some changes?	8	5	3
c) avoid participation in this type of training?	0	2	1

(Avoid participation) mainly because I don't think a lot of people would take it seriously C;

7/ Where would you see this technique being applicable in the military?

Shooting, physical activity or any activity requiring motivation and self-control A; Control breathing for shooting A;

Rifle team, march and shoot competitions, basic infantry A;

Long military exercises in cold temperature under stress (i.e., Alaska) A;

In winter time for your trigger finger A;

Weapons handling and stress control (i.e., Some NCO's flip right out) A;

When in the field A;

With physical training with the breathing A;

Preparing us for forced marches (i.e., 2X10 miles, for our rifle team to control their shooting) A; Shooting, physical fitness A;

It would be applicable to all aspects of the military A;

Once in basic training and in battalion B;
I don't see how the military as a whole would benefit i.e., Production-man management, but for a majority of mature, open minded individuals it would help manage stress B;
I don't see any area of the infantry that could use this type of training B;
In a spin-dry course (Alcoholics Anonymous) B;
Shooting because it helps you relax B;
Mainly during TQ3 when there are a lot of mental and physical tasks asked of you B;
(3) Battle school and Cornwallis B;
High stress jobs B;
For range practice, snipers etc. B;

For snipers or other jobs where body control is important C;
For marching, deliberate shooting, snipers, long range patrolling, mountaineering C;
Air pilots, navy submarines, Recon's/Pathfinders, SAR TEC's. All jobs needing control of both mind and body in high stress situations C;
Personal endurance, field work, Physical Training, PWT's builds self confidence for better teaching of military courses! Many areas!!! C;
Basic training C; Therapy for body injuries, rifle team and snipers C;
In garrison on Thursday afternoons a section of men at a time. Instructor for the mental training must come from outside the military and be free of military influence C;
When performing boring tasks as well as physically demanding ones. Shooting will definitely be affected C;
I think that it would help the average soldier to deal better with stressful situations C;
A few months after TQ3 C; When you're in high stress situations C;

8/ How would you see this technique being useful in the military?

By giving soldiers better knowledge about their limits and themselves A;
More stamina A; When cold and tense A;
It would be useful to all aspects of the military A;
To help the troops to concentrate more on the task at hand A;
For people that are nervous before a shooting A;
Being useful for the individual body of the soldier doing his thing in wartime A;
Lowering the stress levels of soldiers in training A;
Motivation acquired from control of ones body would improve the performance of most soldiers A;

This could be useful in marching (rucksack), marksmanship when soldiers are fatigued by do not have time to sleep etc. B; Relieve and/or control emotions B; I don't really know B;
At the recruit level they would be able to better control their bodies B;
I don't see it being useful B;
On long marches then digging trenches then being put at alert B;
As a relaxation technique where there isn't enough time to get a good rest B;
It would help people with difficulty shooting to relax and concentrate B;
Relax people with high tension mental stress B;
In stress management, if persons weren't trying just to get out of doing something else B;

Help you cope with pressure and stress C;
At stressful times C;
I think this would be useful to all branches of the military C;
If you have better control of your mental body you can last longer in the

field and under stress at an acceptable level C;

Helps people to reduce stress whenever stress is removed, performance usually improves C;

It would help snipers or rifle team members relax when they are firing, and would aid in reducing recovery time of people who are injured C;

When we're on demanding courses, when we need to reach down and give the last 10% and on long exercises C;

It would be best used from basic (rather) than after and start with all levels from private to generals C;

Personnel (would) stay in longer due to useful training human care, cut down on less expensive planes CF 18 less medical problems fit mind fit body. C;

If individuals could adopt the training they could be combined to make a very good team C;

I think it would be useful to the Combat Arms Brigade the most C;

9/ Was your military work load reduced during your two weeks of mental training or were you expected to make up the lost time in work?

My work load increased but I was not required to make up for lost time A;

(3) I was expected to make up for lost time A;

(3) Much the same normal duties A;

I didn't have to go to Suffield but work load remained the same A;

work load was not reduced A;

(2) (work load was) reduced A;

No lost time was to be made up B;

(5) The work load was the same just flexible B;

I was not expected to make up for lost time but I was very busy B;

(4) (work load was) reduced B;

No it wasn't but I didn't have to make up the lost time C;
I don't have much of a work load right now C;
(3) work load was not reduced but was flexible C;
I was expected (had to) make up the lost time, very busy time of the year for store men C;
I had to make for the lost time C;
work load was reduced however the exercise I made up on my own time C; (3) (work load was) reduced C;_

10/ Were your immediate supervisor, friends and other soldiers in your work environment generally supportive, indifferent or nonsupportive of your participation in mental training?

---

(6) Indifferent A;
Most were supportive but some were against this A;
Very supportive during all of the two weeks A;
Generally supportive A;
They were nonsupportive A;
They made fun of it due to lack of understand A;

Immediate supervisor was not supportive B;
(8) Indifferent B;
Supportive B;
Just wanted to know what was being done B;

---

(5) They were indifferent C;
(4) Supportive because they were curious about it C;
They were either indifferent or unsupportive C;

C

They were generally indifferent however if they were to partake, I think some may become quite supportive C;

11/ Do you have any suggestions that you would like to see included as part of future mental training for the military?

Some more intensive mind control exercises would be beneficial A;
Performance enhancement training A;
Stress testing for soldiers and how to cope with it, sorting out soldiers' disposition and attitude A;
Temperature control - Different location - i.e., room was too cold 64°F.
Carpeting would have been nice, more concentration on reducing pulse and more relaxation techniques (possibly some kind of meditation A;
If some people are going to do it everybody should A;
Concentrate more on your heart rate A;
Maybe to start at a new soldier who is in battle school with these mental training periods A;

Longer time period B;
The time factor requires a long period of time to become efficient B;
Use people who have the time to spare before a big exercise B;
A technique to use this on the march B;

Possibly longer and not spliting training to 2 different times C;
Just more time spent on concentration and focusing C;
Do the mental training in very small groups. People (more so army minds) are hard to swing in this type of training C;
I think the military should emphasize the stress reducing training C;
(2) Work on more parts of the body C;

12/ Would you prefer to have military personnel or outside consultants involved in instructing mental training to soldiers?

---

(10) Outside consultants because they're more qualified than most of the military A; Because it would be a relaxed atmosphere A;
Have the personnel of military instructing soldiers the mental training test A;

---

(9) Outside consultants preferably B; Outside consultants who have an idea of what we do B; Outside consultants because the military is not experienced enough in this field B;
Military personnel B;
I think if people wanted to get involved, it shouldn't be forced and it should not be during work hours. That way only non-skeptics would show up B;

---

(6) Outside consultants C;
To whoever knows what they're doing C;
If you use military personnel it wouldn't work. You'll get better results from outside consultants but only until personnel get use to the idea then use army peers C;
Depends on how well the screening process is done for military personnel and whether or not civilians understand our jobs and timing C;
(2) It is good to have a mixture for the experience would be broader and not just one sided opinions C;

13/ For the consultant with whom you had contact, comment on what you liked best and what you think might help him do a better job.

Excellent job, Roger was very professional and was helpful with all aspects of training. He may want to have a better surrounding for future training, soft lights, music, etc. A;

Very knowledgeable, friendly and relaxed A;

Very helpful but needs to relax more not just do this now, basically understanding A;

The consultant was very relaxed which made the volunteer participants more relaxed. The consultant also seemed very professional and knew what he was talking about A;

Good relaxed atmosphere A;

If he look carefully if the personnel want to do it or not A;

He was friendly and helped, couldn't ask for better help A;

The consultant was easy to talk to and made the atmosphere in the classroom very relaxing and at ease A;

I think he did a superb job and should keep up the good work, he really helped me a lot A;

Very supportive and was interested in our day to day job A;

Nothing, he was a great consultant and did a great job B; Relax! (Hope the study will show you something) B;

Fairly helpful B;

If the proper environment was available to him B;

He was understanding of our other commitments B;

He was good, he asked for comments and left us to do what we had to do B;

He was easygoing and I was able to talk to him, have him relax a bit more and don't have him try to make things work all the time B;

The person was easy to talk to and answered all our questions B;

He had a good knowledge and was friendly no comment on ability for him to get better B;

He was friendly and cared about what he did B;
The program was good and all but the consultant didn't seem to understand that some work had to be done therefore causing some missed sessions B;

He was very helpful and answered all our questions and explained things very well C;
He was very informative and thorough. He seemed enthusiastic about his job, and was quite interesting C;
Very easy to work with, knowledgeable on subject and why we are doing it. He seemed to have both feet firmly on the ground i.e., an air of calm and understanding C;
His open mind, understanding and all-around attitude is what kept me interested. Very knowledgeable and easy to talk to. I wish we had more time C;
He was generally interested and supportive. He should observe us on exercise to get a better idea of our job! So he could understand how we can apply what he has taught us. Good Luck!!! C;
He explained fully everything we had to do and tried to make us feel at ease C;
Our consultant was easy going and genuinely interested in us as individuals. The only improvement that he could make would have been to have more time to work with us. Two weeks wasn't enough C;
I felt he knew what he was doing and was quite competent C;
I think he did a great job and the relaxed environment made the training much better C;
He did a great job, very supportive and taught me a lot of things C;
I liked the relaxation part of the training C;

APPENDIX AF

RESPONSES TO THE POST-MARCH 2 QUESTIONNAIRE

	A	Score			B	Score			C	Score		
When used most?	2	3	3	2	3	5	5	2	0	4	8	4
	No	Be	Mid	Late	No	Be	Mid	Late	No	Be	Mid	Late

	A	B	C
1 Mental Training % use	360	320	500
2 Effectiveness	380	320	490
3 Pain relief	320	340	560
4 Boredom reduction	360	380	490
5 More relaxed in march	480	430	530
6 Relax T. 1 v.s. T. 2	480	630	600
TOTAL	2380	2420	3170
MAX	480	630	600
MIN	320	320	490
AVG	397	403	528

# of resp.

8 What helped most? A

* Temperature and heart rate control.
* Controlling my mind for heart rate as well as pain.
* The Electromyogram.
* Learning how to relax fully.
* Slowing heart rate.
* My shooting.
* It helped me put heat in my knee.

8 What helped most? B

* Being able to forget about the pain.
* The ability to lower heart rate.
* Thinking of other things.

- To relax.
- 2 Nothing.
- Not applicable.
- Able to tell myself I could do it.
- Being able to relax in a quiet atmosphere.

8 What helped most? C

- Focusing my mind on other things or nothing at will.
- Preoccupying your mind.
- None of it.
- Passing the time; Switching off the feelings in my legs
- The lowering of heart rate.
- Target practice.
- The ability to relax myself during the march was easier this time.
- It didn't help at all for the march.
- Time passing, reduced boredom very much.
- Focusing on picture.

APPENDIX AG

Blood Lactate Analysis

Two-Way Analysis of Variance on Levels of Blood Lactates during the Weight-Loaded March

Between Subject Factors are:

A	1	2	3	4
Groups:	Biofk	Med.	Combined	Control

Within Subject Factors are:

B	Trial 1	Trial 2
Times :	Blood Lactate	Blood Lactate

Source	Sum of Squares	Degrees Freedom	Mean Squares	F Ratio	Prob.
A	12.930	3	4.310	2.325	0.093
S-Within	59.306	32	1.853		
B	1.151	1	1.151	0.796	0.379
AB	3.662	3	1.221	0.845	0.480
BS-Within	46.250	32	1.445		

Significance level * 0.05
** 0.01

SOURCE: AB

B	1	2	
Times :	Blood Lactate	Blood Lactate	AVERAGE
A: GROUP =			
1 Biofk	2.844	2.850	2.847
2 Med.	1.600	1.918	1.759
3 Comb.	3.042	2.583	2.812
4 Control	2.901	1.991	2.446
AVERAGE	2.514	2.258	

There were no differences in blood lactate levels in trial 1 and trial 2 for all groups. No significant differences were found in the main (p=0.093), time (p=0.379) and interaction effect (p=0.480).

APPENDIX AH

Pre and Post Measures for Meditation Training

TABLE 1

Mean Scores for Self-Confidence Before and After Meditation for the Meditation Group

Group 1 - Pre - meditation (am)
Group 2 - Post - meditation (am)

VARIABLE	No. OF CASES	MEAN	STD DEV.	STD ERROR	T VALUE	TWO-TAIL PROB.
Time 1						
Group 1	10	44.800	7.598	2.403	-4.58	0.001 **
Group 2	10	52.800	7.300	2.308		

TABLE 2

Mean Scores for Cognitive Anxiety Before and After Meditation for the Meditation Group

Group 1 - Pre - meditation (am)
Group 2 - Post - meditation (am)

VARIABLE	No. OF CASES	MEAN	STD DEV.	STD ERROR	T VALUE	TWO-TAIL PROB.
Time 1						
Group 1	10	18.900	4.228	1.337	2.74	0.023 *
Group 2	10	16.900	2.470	0.781		

TABLE 3

Mean Scores for Self-Confidence Before and After Meditation for the Combined Group

Group 1 - Pre - meditation (pm)
Group 2 - Post - meditation (pm)

VARIABLE	No. OF CASES	MEAN	STD DEV.	STD ERROR	T VALUE	TWO-TAIL PROB.
Time 1						
Group 1	8	95.500	10.569	3.737	-4.60	0.002 **
Group 2	8	109.750	6.964	2.462		

TABLE 4

Mean Scores for Cognitive Anxiety Before and After Meditation for the Combined Group

Group 1 - Pre - meditation (pm)
Group 2 - Post - meditation (pm)

VARIABLE	No. OF CASES	MEAN	STD DEV.	STD ERROR	T VALUE	TWO-TAIL PROB.
Time 1						
Group 1	8	36.000	4.440	1.570	2.30	0.055 *
Group 2	8	33.500	4.567	1.615		

APPENDIX AI

Descriptive Results During Two Weeks of Mental Training

Biofeedback via Electromyogram began with having the soldiers focus on lowering muscular tension of the forearm flexors (the support arm for the rifle). After three sessions of lowering tension, subjects were asked to tense forearm as much as possible and to let go immediately. The monitoring needle of the EMG normally reached 10 Mvolts and was dropped down to 0.5 Mvolts within a matter of seconds. The subjects had reached criterion once they could drop the needle from 10 Mvolts to 0.5 Mvolts without hearing a single auditory signal from the EMG. This procedure was done at a variety of scales from 3.0, 1.0, 0.3 to finally 0.1. The intention of the training was to enable the soldier to release as much tension quickly as possible.

Biofeedback Group: Tension (in Microvolts)	April 30	May 10
	2.00	0.6
	1.73	0.3
	0.6	0.57
	1.5	0.38
	1.5	0.45
	1.75	0.5
	1.25	0.5
	0.38	0.5
	0.83	0.15
	0.75	0.5
	2.75	0.45
TOTAL	15.04	4.90

Digital temperature training involved wrapping a Biotic band around the trigger finger and warming it by thinking about the finger being warm. The rationale for this training relates to the fact that a cold finger is less sensitive on a trigger than a warm finger. As well, peripheral temperature training has been used extensively for training relaxation habits.

Skin Temperature Training Chart

Differences from initial temperature to final temperature (In degrees ^{o}F)

	May 4/7	May 9/10/11
	0.0	10.0
	9.5	8.5
	2.5	11.5
	2.0	2.0
	1.0	5.0
	4.0	5.5
	4.0	11.0
	0.0	5.0
	3.5	7.0
	1.5	1.0
	1.0	20.0
TOTAL	29.0	86.5

Heart rate was measured by way of a Sport Tester. Soldiers were initially asked to lower their heart rates as low as possible and to monitor themselves every 3 to 5 minutes. After about 4 sessions, soldiers were asked to lie in a prone position and pretend they had a rifle (C7) in hand as they aimed while monitoring their heart rate. The following day, the same drill was repeated with a C7 rifle. Soldiers were asked to run for 50 meters, lie down and shoot three dry shots (without ammunition) while monitoring their heart rates. Therefore as they lied down after the run, they recorded their heart rate. After the first shot they checked their heart rate again. This was done for the two following shots. Paced breathing was recommended to lower their heart rates. This strategy was used to familiarize the soldiers with having to lower their heart rate quickly to shoot more accurately.

Heart Rate Training Chart

Lowest heart rate for the session

(In beats/min.)

	May 2	May 10/11
	40	38
	52	70
	53	55
	73	53
	64	54
	54	72
	45	50
	63	64
	71	83
	58	62
	66	69
TOTAL	639	670

Combined Group: Tension (microvolts)

	April 30	May 10
	0.75	0.5
	4.3	0.3 *
	5.1	0.3 *
	0.21	0.5
	0.9	0.27
	1.8	0.5 *
	0.3	0.5
	0.45	0.15
	0.45	0.3
	1.1	0.45
	0.525	0.315
TOTAL	15.885	4.085

Skin Temperature Training Chart

Differences from initial temperature to final temperature (In °F)

	May 4/7	May 9/10/11
	3.0	3.0
	5.0	12.0
	2.5	9.0
	6.0	15.0
	2.0	14.0
	5.0	11.5
	3.5	4.0
	3.5	3.5
	2.0	11.0
	2.0	8.0
	4.0	5.0
TOTAL	38.5	96.0

Heart Rate Training Chart

Lowest heart rate for the session (In beats/min.)

	May 2	May 10/11
	74	76
	57	71
	63	71
	67	62
	61	65
	56	54
	57	61
	56	68
	53	68
	58	62
	49	70
TOTAL	651	728

APPENDIX AJ

Research Schedule

APRIL

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
22 set up in Calgary	23am #A pm	24am #B pm	25am #C pm	26am #D pm	27am #E pm	28am #F pm
29am #G pm	30 Begin Treatment	MAY				
		1 Treatment	2 Treatment	3 Treatment	4 Treatment	5 Off
6 Off	7 Treatment	8 Treatment	9 Treatment	10 Treatment	11 Treatment	12 Off
13 Off	14am TEST #A pm	15am TEST #A pm	16	17	18	19

APPENDIX AK

ROLLING THUNDER

Artillery Training at the Suffield Military Base In Alberta

The Control Group

April 30 to May 11

Three soldiers remained in Calgary and performed their normal everyday duties.

One soldier's tasks - worked in stores which involved light lifting (a maximum of 40 lbs), paperwork, cleaning and inspecting equipment. The soldier did no physical training during the two weeks.

One soldier's tasks - worked as a clerk which involved filing, typing, running errands. No physical training was done during the two weeks.

One soldier's tasks - worked as a social events manager which involved organizing social activities at the Officers' Mess, ordering supplies and ensuring that logistical tasks are performed. Physical training was done on a daily basis.

Soldiers in Suffield

Two soldiers - storemen on the field.

Light work (maximum lifting was 40 lbs).

Delivered mail and crates of small arms ammunition.

Delivered hay box meals to various locations.

Their tasks also involved some driving and setting modular tents up.

Worked from 06:00 to 23:00.

Did not partake in physical training while in Suffield.

One soldier - Driver for the entire two weeks.

Worked from 08:00 to 20:00. His tasks involved driving, maintenance and minor repairs. No physical training was done while in Suffield.

Five soldiers - Riflemen.

Worked generally form 08:00 to 19:00 hours daily.

Practised Section Attacks (pepper plotting for the last 100 m)

In partners, one takes three or four strides, shoots at the enemy and drops. The partner then passes him/her by three or four strides and shoots. This procedure continues for about 100 meters. This is done while wearing full fighting order. This drill was performed for three days.

Practised Company Attacks

In mechanized attack teams, C-7, C-6, tanks, etc. were used in their approach toward the enemy. Soldiers trained for two days.

Live fire range training included

a) Section bunker clearance
b) Anti-tank firing, M72 and 84 mm guns
c) Small arms firing including the 50 cal MG
d) grenade range

Battle drills (e.g., dry firing, live firing on ranges, 100 m - 150 m, throwing grenades, machine gun firing, C-6; 50 cal., etc.).Contact drills (e.g., gap drills, defile drills, ambush drills and obstacle drills were all done during constant constant walking,

Kitchen Duty (clean up)

General Duty (e.g., setting up and taking tents of varying sizes down, general tent routines, cleaning, etc.). All of these soldiers performed no physical training while in Suffield although when performing section attacks, contact drills and battle drills, soldiers were wearing their fighting order at all times.

According to Leftenant D.G. Bourne, this in itself would have made up for the physical training they missed.

Soldiers slept in 10-person modular tents for the duration of the two weeks. The weather was generally cool to cold with very strong winds on a few days (some tents were blown down). Windblown dust is also a factor because of the limited number of trees.